

CvK-H03498-B-P024399

[FOUNDED IN 1906 AS THE AMERICAN QUARTEELY OF ROENTGENOLOGY]

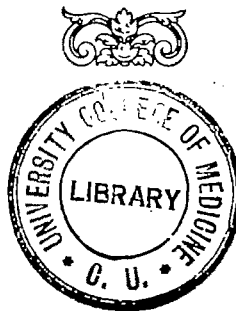
The  
AMERICAN JOURNAL  
OF ROENTGENOLOGY  
AND RADIUM THERAPY

*Editor:* LAWRENCE REYNOLDS, M.D.

5

VOLUME XXIV

JULY TO DECEMBER 1930



CHARLES C. THOMAS :: SPRINGFIELD, ILLINOIS  
MCMXXX



COPYRIGHT, 1930  
By AMERICAN ROENTGEN RAY SOCIETY, INC.

5111

P 24,399

# CONTENTS OF VOLUME XXIV

## ORIGINAL ARTICLES

Colon Studies. VI. Cecal Stasis . . . . .	{ <i>John L. Kantor, M.D.</i> . . . . . <i>Samuel Schechter, M.D.</i> . . . . . <i>Jerome A. Marks, M.D.</i> . . . . . }	1
The Interpretation of Sinus Roentgeno- grams . . . . .	<i>G. W. Grier, M.D.</i> . . . . .	21
Pseudofractures (Hunger Osteopathy, Late Rickets, Osteomalacia) . . . . .	<i>L. A. Milkman, M.D.</i> . . . . .	29
Anomalous Enlargement of the Liver and a Dissecting Hematoma of the Phrenic Nerve . . . . .	{ <i>Karl Kornblum, M.D.</i> . . . . . <i>George W. Stephenson, M.D.</i> . . . . . }	38
The Reaction of Lymphoid Tissue to Roentgen Radiation . . . . .	{ <i>Hachiro Akaiwa, M.D.</i> . . . . . <i>Mitsuzo Takeshima, M.D.</i> . . . . . }	42
Complications in the Urinary Tract Due to Carcinoma of the Uterine Cervix or Radiation Treatment . . . . .	<i>Henry Schmitz, M.D.</i> . . . . .	47
Results Obtained in the Treatment of Car- cinoma of the Cervix Uteri with Radium and Roentgen Rays from 1915 to 1923, Inclusive . . . . .	{ <i>Harry H. Bowing, M.D.</i> . . . . . <i>Arthur U. Desjardins, M.D.</i> . . . . . <i>Leda J. Stacy, M.D.</i> . . . . . <i>J. Herbert Bliss, M.D.</i> . . . . . }	54
Carcinoma of the Ovary . . . . .	<i>A. W. Jacobs, M.D.</i> . . . . .	63
The Construction and Calibration of a Standard Dosimeter . . . . .	<i>Robert B. Taft, B.S., M.D.</i> . . . . .	72
A Roentgenologic Study of the Breast . . . . .	<i>Stafford L. Warren, M.D.</i> . . . . .	113
Subphrenic Abscess . . . . .	<i>E. P. McNamee, M.D.</i> . . . . .	125
The Roentgen Appearance of the Chest of the New-Born Infant . . . . .	<i>John T. Farrell, Jr., M.D.</i> . . . . .	140
The Development of Marble Bones . . . . .	<i>A. Howard Pirie</i> . . . . .	147
The Uncoiled Aorta. Part II. The Path- ologic Aorta . . . . .	<i>David S. Dann, M.D.</i> . . . . .	154
The Treatment of Angina Pectoris by Para- vertebral Short Wave Radiation . . . . .	<i>Marcy L. Sussman, M.D.</i> . . . . .	163
Therapeutic Lead Poisoning . . . . .	<i>Sanford Withers, M.D.</i> . . . . .	69
The Relative Value of Radium in the Treatment of Cancer . . . . .	<i>M. J. Sittenfield, M.D.</i> . . . . .	180
Sarcoma of the Prostatic Area in an Infant Aged Four Months . . . . .	<i>Gerard Raap, M.D.</i> . . . . .	185
Automatic Electric Horizontal and Vertical Serialograph . . . . .	<i>Moses Einhorn, M.D.</i> . . . . .	200
Mediastinal Pleural Effusion . . . . .	{ <i>Jacob Sagel, M.D.</i> . . . . . <i>Leo. G. Rigler, M.D.</i> . . . . . <i>Eugene P. Pendergrass, M.D.</i> . . . . . }	225
Bone Lesions in Tardive Heredosyphilis . . . . .	{ <i>Robert L. Gilman, M.D.</i> . . . . . <i>Kenneth B. Castleton, M.D.</i> . . . . . }	234
Roentgenologically Demonstrable changes in Bone in Gaucher's Disease . . . . .	{ <i>B. R. Kirklin, M.D.</i> . . . . . <i>Hans W. Hefke, M.D.</i> . . . . . }	258

Sarcoma of the Rib . . . . .	{ Robert J. Reeves, M.D. . . . . H. H. Kasabach, M.D. . . . . }	262
Menstrual Headaches . . . . .	Charles L. Martin, M.D. . . . .	267
Ten Years' Results with Radium in the Treatment of Toxic Goiter . . . . .	R. E. Loucks, M.D. . . . .	280
The Value and Place of Radium in Treat- ment of Diseases of the Thyroid Gland . . . . .	Solomon Ginsburg, M.D. . . . .	283
Barium Enema Entering Esophagus . . . . .	Clinton G. Lyons, M.D. . . . .	300
Cholecystography in the Left Lateroan- terior Position . . . . .	{ I. W. Held, M.D. . . . . A. Allen Goldbloom, M.D. . . . . }	313
Automatic Polarizer for Synchronous Rec- tifier . . . . .	Robert B. Taft, B.S., M.D. . . . .	317
The Roentgenologic Diagnosis of Coarcta- tion of the Aorta (Adult Type) . . . . .	Walter W. Fray, M.S., M.D. . . . .	349
Amniography . . . . .	{ Thomas O. Menees, M.D. . . . . J. Duane Miller, M.D. . . . . Leland E. Holly, M.D. . . . . }	363
The Diagnosis of Early Ileocecal Tubercu- losis . . . . .	J. Gershon-Cohen, M.D. . . . .	367
The Normal Position of the Patella . . . . .	S. B. Boon-Itt, M.D. . . . .	389
Results of Roentgen Therapy in Goiter, Based upon Observations in Four Hun- dred Cases . . . . .	{ George E. Pfahler, M.D. . . . . Jacob H. Vastine, M.D. . . . . }	395
The Treatment of Carcinoma of the Body of the Uterus . . . . .	William Neill, Jr., M.D. . . . .	412
The Detection, Estimation and Elimina- tion of Radium in Living Persons Given Radium Chloride Internally. II. . . . .	{ Howard H. Barker . . . . . Herman Schlundt . . . . . }	418
Thyroglossal Duct Cyst and Sinus . . . . .	Paul O. Snoke, M.D. . . . .	424
Syphilitic Infection of the Lung . . . . .	Howard J. Hutter, M.D. . . . .	427
A Case of Right-sided Relaxation of the Diaphragm . . . . .	Hans Fritsch . . . . .	430
A Convenient Method for Making Radium and Radon Surface Applicators, Plaques and Packs . . . . .	Ira I. Kaplan, M.D. . . . .	442
Campidol (Iodized Rapeseed Oil) . . . . .	Mark Albert Glaser, M.D. . . . .	477
Mikulicz's Disease and the Mikulicz Syn- drome . . . . .	{ T. Leucutia, M.D. . . . . A. E. Price, M.D. . . . . }	491
Unusual Cholecystograms and Their In- terpretation . . . . .	A. J. Delario, M.D. . . . .	516
Hyperplasia of the Thymus . . . . .	Sam W. Donaldson, M.D. . . . .	523
Angio- (Perivascular) Endotheliomas about the Jaws . . . . .	Sanford Withers, M.D. . . . .	534
A Clinical Evaluation of Radium Therapy in Advanced Cancer with Various Com- binations of Wave Lengths . . . . .	{ Bernard P. Widmann, M.D. . . . . J. L. Weatherwax, M.A. . . . . }	540
A Roentgen Sign of Plumbism . . . . .	Edward C. Vogt . . . . .	550
The Roentgenologic Diagnosis of Papilloma of the Duodenum . . . . .	Charles A. Waters, M.D. . . . .	554

Aneurysm of the Horizontal Aortic Arch, with Autopsy . . . . .	<i>George Rosenbaum, M.D.</i> . . . .	558
The Cin-ex Camera . . . . .	<i>Hans A. Jarre, M.D.</i> . . . .	575
The Development of Modern Roentgen- Ray Generating Apparatus . . . . .	<i>W. D. Coolidge, Ph.D.</i> . . . .	605
The Symphysis Pubis in the Roentgen Examination of the Sacroiliac Joint. . . . .	<i>W. Edward Chamberlain, M.D.</i> . . . .	621
The Effect of Phrenicectomy on Pulmonary Cavitation . . . . .	<i>Walter I. Werner, M.D.</i> . . . . <i>E. J. O'Brien, M.D.</i> . . . .	626
The Roentgen Diagnosis of Chronic Appen- dicitis . . . . .	<i>Henry J. Walton, M.D.</i> . . . . <i>Samuel Weinstein, M.D.</i> . . . .	631
Roentgen-Physiological Studies on the Gall-Bladder . . . . .	<i>Allan G. Rewbridge, M.D.</i> . . . . <i>Béla A. Halpert, M.D.</i> . . . .	634
Experimental Studies on Tissue Reaction to Radiation Using a Segment of a Growing Mouse Tail as a Biological In- dicator . . . . .	<i>Halsey J. Bagg, Ph.D.</i> . . . . <i>C. Robert Halter, M.A.</i> . . . .	640
Blood Changes in the Leucemias and the Lymphomata and Their Bearing on Roentgen Therapy . . . . .	<i>Raphael Isaacs, M.A., M.D.</i> . . . .	648
The Roentgen Treatment of Metastasis to the Vertebrae and the Bones of the Pelvis from Carcinoma of the Breast . . . . .	<i>Eugene T. Leddy, M.D.</i> . . . .	657
Deep Roentgen-Ray Therapy of Mammary Carcinoma. II. Five Year Results . . . . .	<i>William A. Evans, M.D.</i> . . . . <i>T. Leucutia, M.D.</i> . . . .	673
Traumatic Rupture of the Diaphragm . . . . .	<i>L. F. Wheatley, M.D.</i> . . . .	679
Diverticulum of the Duodenum Perforated into the Pancreas . . . . .	<i>Joseph H. Lucinian, M.D.</i> . . . .	684



# THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. XXIV

JULY, 1930

No. 1

## COLON STUDIES

### VI. CECAL STASIS: ITS CLINICAL SIGNIFICANCE AND RELATION TO PROXIMAL COLON STASIS\*†

By JOHN L. KANTOR, M.D., SAMUEL SCHECHTER, M.D., and JEROME A. MARKS, M.D.  
NEW YORK CITY

THE development of our present knowledge of proximal colon stasis‡ may be briefly summarized as follows:

The "modern era" opens in Germany in 1908 when Wilms published his historic paper on cecum mobile as the cause of many cases of so-called chronic appendicitis, and recommended cecopexy for the relief of this condition. The following year (1909) Klose also began writing on the mobile cecum and reported some of the earliest roentgen studies of cecal stasis. Two years later he described the operation of right colopexy which is perhaps the type of surgical procedure most commonly employed in this country at the present time. That same year (1911) there appeared the first important roentgen study in this field, namely, that by Stierlin on obstipation of the "ascendens" type.

At about this time (1910) Roux published the first of his papers, later collab-

orating with Duval and laying a firm foundation for the French school by his clear differentiation between right-sided and left-sided colonic stasis.

In the meanwhile (1904-1918), in England, Lane's gospel that intestinal stasis caused the formation of bands representing the "crystallization of lines of force" had resulted in an initial overemphasis of the radical surgical treatment of all forms of constipation. Much of the support for Lane's theories was furnished by Jordan's roentgen studies, although it was not till 1924 that these appeared in book form. In 1912 the British physiologist Keith first pointed out the persistence in man of the ceco-colic sphincteric tract, but it remained for Hirsch, of New York (1924), to work out the clinical significance of this condition. In 1915 Walton wrote a stimulating paper on the clinical aspects of visceroptosis in which he advocated the cutting of bands and the freeing of adhesions involving the right colon.

By 1912, interest in this subject had already become manifest in this country, for it was in that year that Coffey published his original ideas on the principles underlying the surgical treatment of gastrointestinal stasis. Just about this time, Case began his indefatigable researches on colon function which led him first (1914) to

\* Read at the Thirtieth Annual Meeting, American Roentgen Ray Society, New York City, Sept. 17-20, 1929.

† This is the sixth of a series of articles: 1. The redundant colon, *Am. J. Roentgenol. & Rad. Therapy*, 1924, 12, 414; 11. The low cecum. *Ibid.*, 1925, 14, 207; 111. The clinical significance of ileal stasis; its association with colitis. *Ibid.*, 1926, 16, 1; 1v. The roentgen diagnosis of colitis (the irritable colon). *Ibid.*, 1927, 17, 405-416; v. The high cecum. *Ibid.*, 1928, 19, 101-111.

‡ Throughout this paper the term "proximal colon stasis" will be used to indicate the general idea of retention in the right third of the large intestine. When particular reference is necessary to the exact location involved, the terms "cecal stasis" and "ceco-colic stasis"—the latter indicating retention from caput coli to hepatic flexure—will be employed.



believe that the fixed rather than the movable cecum was more likely to cause stasis, and brought him later (1922) to the important conclusion that proximal colon stasis was due principally to exaggerated anti-peristalsis which was caused in turn by factors originating in the distal colon. During this period Quain had also become interested in the relation between right coloptosis and duodenal obstruction, and by 1924 was able to publish his results in 52 patients, operated on by various procedures, with follow-up periods varying from one and one-half to five and one-half years.

Apart from the studies already mentioned, noteworthy roentgen contributions were those of Bensaude (1919) in France, and of Hurst (1919) in England, on the roentgenology of constipation in general, and of Bassler (1922), and of Cunningham (1923) in this country, on stasis in the cecum and ascending colon.

From the beginning of the period under discussion, practically all the European

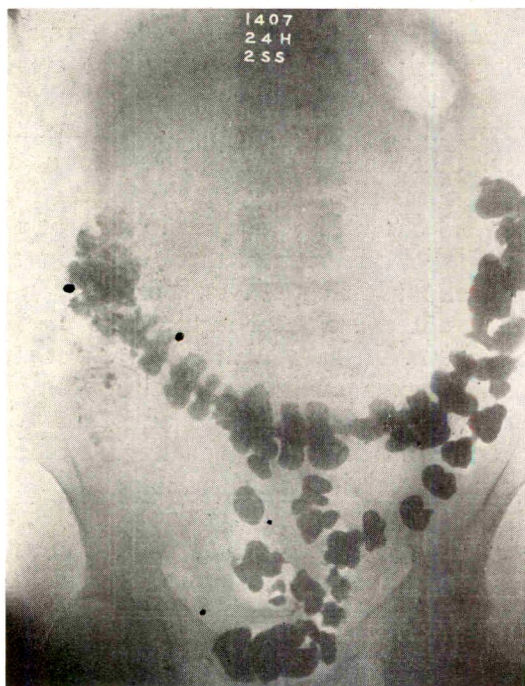


FIG. 1. Cecal non-stasis. Appearance 24 hours after opaque meal; two stools. Ceco-colon empty.

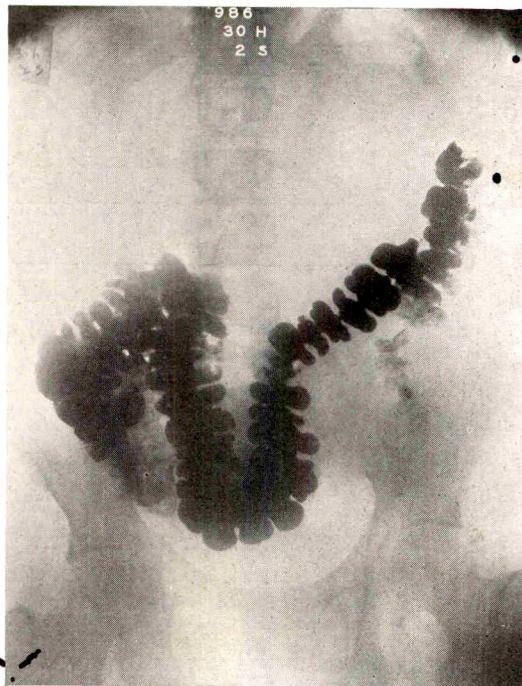


FIG. 2. Cecal non-stasis, despite angulation of proximal transverse colon. Appearance 24 hours after opaque meal; two stools. Ceco-colon still filled. Same case as Figure 3.

writers have insisted, with justice, on resurrecting the old clinical concepts of typhlatony, typhlitis, and perityphlitis, associating these conditions with proximal colon stasis. In this connection the early work of Wilms, Klose, Stierlin and Hurst, as well as Harvier's description of the localized colitides<sup>5</sup> will be found of interest. In the same work appears a helpful exposition of the coprologic findings in these conditions.

The past decade has witnessed some particularly important surgical contributions. In France, Duval and Roux brought out a well-rounded study of ceco-colic stasis in 1920; de Martel and Antoine published their book on "false appendicitis" in 1922; Desmarest and Mercier reported 20 cases of right colectomy in 1924; and in 1927, Duroux advocated division of adhesions and cecoplication for stasis due to right pericolicitis. During the same interval two



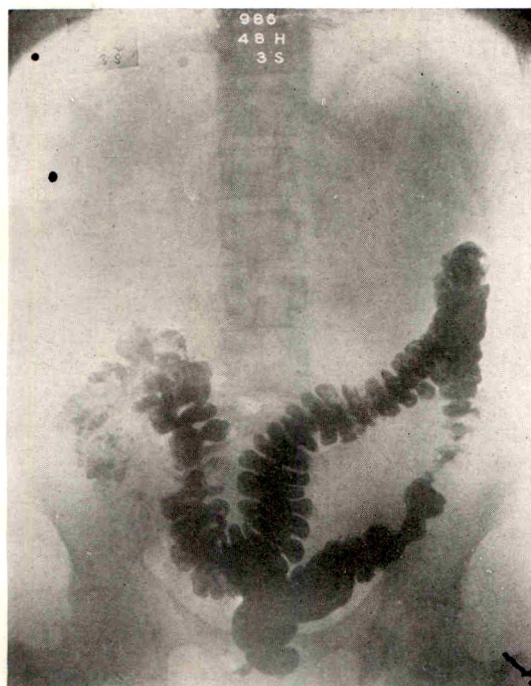


FIG. 3. Cecal non-stasis, despite angulation of proximal transverse colon. Appearance 48 hours after opaque meal; three stools. Ceco-colon empty. Same case as Figure 2.

outstanding surgical contributions appeared in England. The first was Waugh's monograph (1920) on the "morbid consequences of a mobile ascending colon," the other Carslaw's splendid review (1928) on "right-sided visceroptosis." Gray's work in Canada (1924) must also be mentioned in this connection.

Despite the early studies by Coffey and Case and the more recent contributions of Hirsch and Quain already noted, it cannot be said that American interest in this field has kept pace with all the latest developments. To be sure, our own study of the low cecum in 1924 brought out some significant clinical relationships, but the rôle of cecal stasis was not carefully worked out, nor was any attempt made to elucidate the mechanism of the symptoms reported. The failure of appendectomy in relieving so-called chronic appendicitis has created a more conservative attitude, so that recent

reports of surgical treatment of these conditions have been practically lacking. Fortunately, Houston's well-tempered paper on right-sided malposition of the colon, which has just appeared, reporting his personal experience with both medical and surgical treatment, will undoubtedly serve to reopen healthy interest, and stimulate further inquiry into the possibilities of surgical relief in this field of medicine.

#### OBJECTIVES, METHODS, CRITERIA

The present study does not profess to cover all the aspects of the problem. We have been particularly interested in obtaining answers to such rather elementary questions as: What are the exact roentgen criteria of proximal colon stasis? What effects can with certainty be ascribed to this condition? By what mechanism are such effects brought about? To this end, we reviewed a total of 2327 histories of private patients complaining of various digestive



FIG. 4. Cecal stasis. Appearance 24 hours after opaque meal; no stools. Same case as Figures 5, 6 and 7.



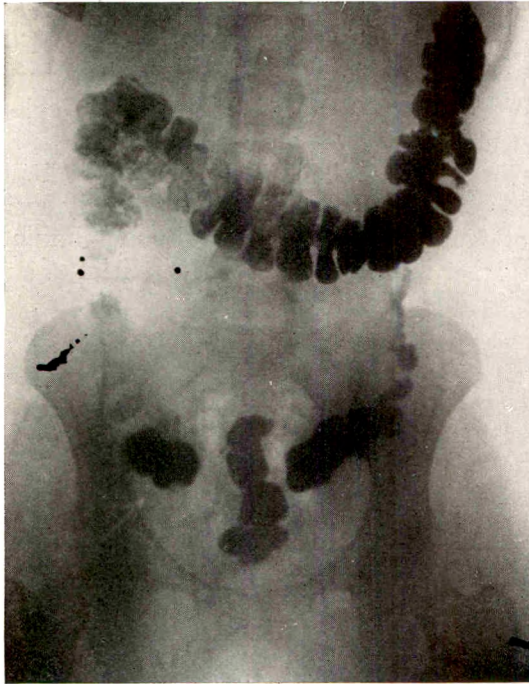


FIG. 5. Cecal stasis. Appearance 48 hours after opaque meal; two stools. Same case as Figures 4, 6 and 7.

disorders. The material was similar to that previously utilized for this series of papers. Of the patients above mentioned, 1430 were examined roentgenologically, and of these, 959 were found available for the present investigation. In practically every one of these 959 cases, the opaque meal was followed at daily or more frequent intervals until the barium was entirely eliminated from the colon.

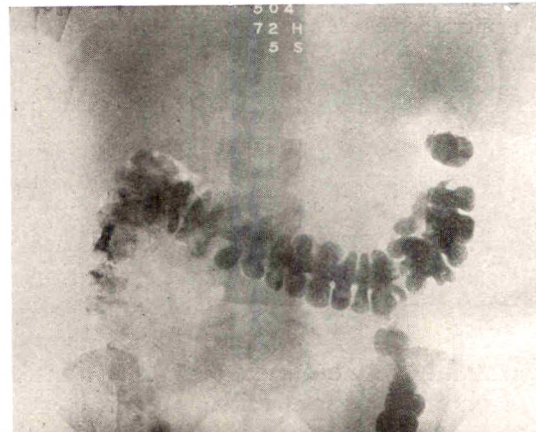
We began our task by reviewing in a general way the emptying of the colon, and found that in the normal individual this

empty into the adjacent colon before the latter expels its contents, it follows that in general, any relative lagging in the evacuation of the proximal colon may be regarded as abnormal, regardless of the absolute time factors involved.

With these impressions in mind, we proceeded to a more detailed investigation of the emptying of the proximal colon and found that roughly, three conditions could be differentiated, namely, cecal and ceco-colic non-stasis, cecal stasis, and ceco-colic stasis. These three classes could be further subdivided into six mutually exclusive\* possibilities. These may be defined and described as follows:

1. Cecal and ceco-colic non-stasis, in which the cecum shows no tendency to pocket at any time and in which the entire proximal colon is empty within forty-eight hours after the administration of the bar-

\* There were of course borderline cases, troublesome to classify and all the usual gradations in each group, from slight to well-marked examples.





ium meal. This is the "normal" condition (Figs. 1, 2 and 3).

2. Cecal stasis, in which a residue persists in the cecum proper for at least forty-eight hours after a barium meal, with the adjacent colon empty. This pocketing may remain as long as six days and even strong aperients may not dislodge it (Köhler, Schlesinger) (Figs. 5, 6, 7, 14, 15 and 20).

3. Twenty-four hour cecal stasis, in which a residue persists in the cecum proper for twenty-four hours only, with the adjacent colon empty (Fig. 8).

4. Secondary ceco-colic stasis, in which a residue persists in the ceco-colon for at least forty-eight hours with the adjacent transverse and distal colon filled (Fig. 17). When the ceco-colon finally empties in these cases, it empties without cecal pocketing. Otherwise these cases would properly be considered instances of cecal stasis.

5. Primary ceco-colic stasis, in which a residue persists in the ceco-colon for at

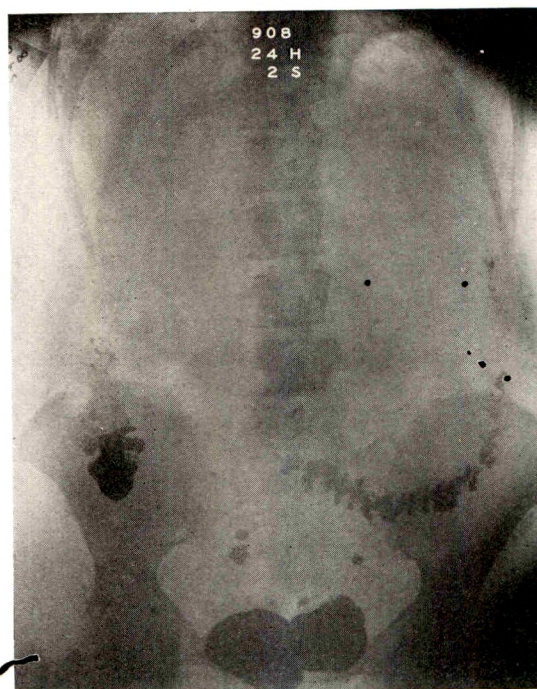


FIG. 8. Twenty-four hour cecal stasis. Appearance 24 hours after opaque meal; two stools. The

written about it, because it is a striking condition easily diagnosed roentgenologically, and because of the possibility that the more proximal the stasis, the more clear-cut should be any clinical picture that might result from such stasis.

#### ETIOLOGY

Many theories have been advanced to explain the phenomenon of stasis in the proximal colon. As a matter of fact, little, if any, experimental evidence has been adduced in support of these views. Perhaps a brief statement of some of the current hypotheses may prove of interest.

Cecal stasis was originally attributed to the presence of pericecal adhesions, either congenital in nature or resulting from appendicial inflammation. Although the influence of such adhesions, particularly when they cause manifest deformity, cannot be discounted (Figs. 13, 14, 15 and 16), it remained for Keith, and particularly for Hirsch, to point out the rôle played by the persistence in man of the ceco-colic sphinc-

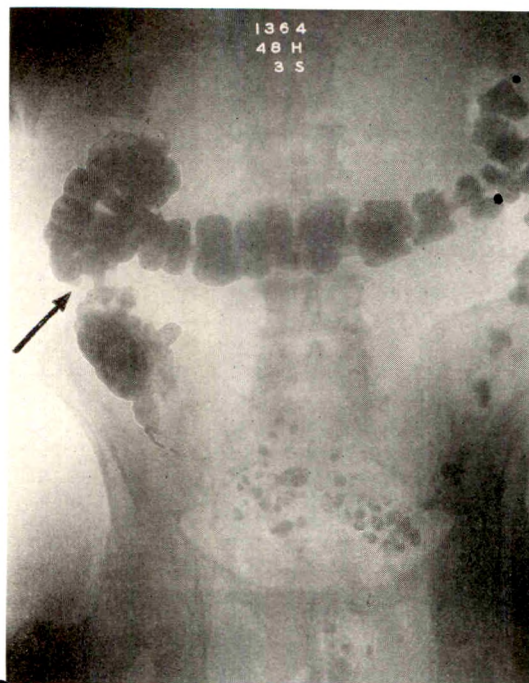
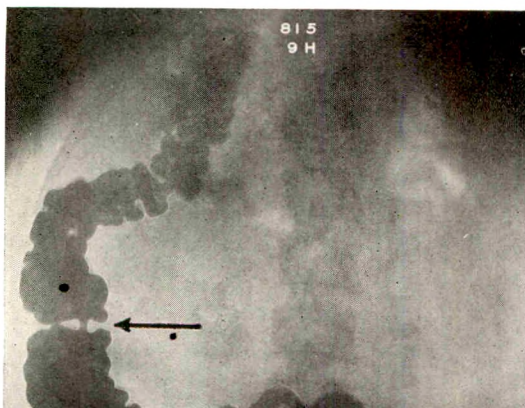


FIG. 10. Ceco-colic sphincter spasm (arrow). Appearance 48 hours after opaque meal; three stools.



ter found in some of the lower animals. According to this viewpoint which is now rapidly gaining ground, a spasm of the ceco-colic sphincteric tract, resulting from either local or distant causes may serve to close off the cecum proper with pocketing and stagnation in this region. Doubtless many observers have encountered roentgenograms strongly suggestive of the presence of such a sphincter, both after an opaque meal, and before and after the evacuation of a barium enema (Figs. 9, 10, 11 and 12). It must be pointed out, however, that not every case in which a ceco-colic



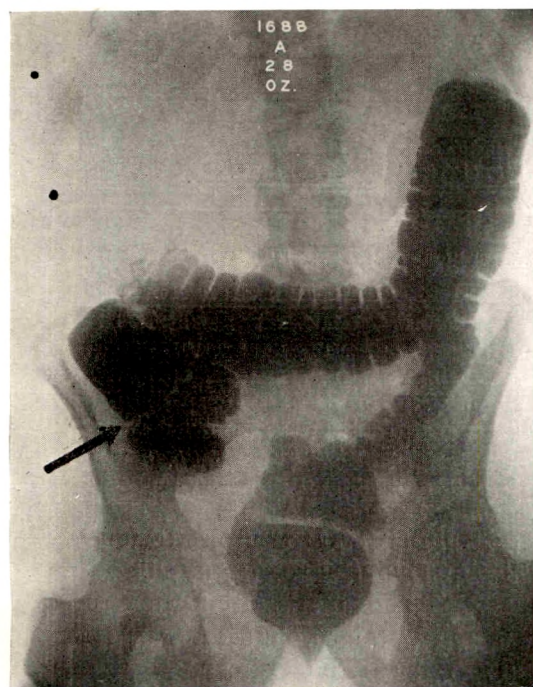


FIG. 11. Ceco-colic sphincter spasm (arrow). Opaque enema. There was no cecal stasis after the barium meal. Same case as Figure 12.

tic activity is usually found in the distal colon, the most frequent etiologic factor being spastic constipation, although organic lesions may also play a rôle.

#### INCIDENCE

*General.* Cecal stasis proper occurred in 265, or about 27 per cent, of our 959 cases, whereas twenty-four hour cecal stasis occurred in 4 per cent. Secondary ceco-colic stasis was encountered 98 times, an incidence of 10 per cent. Primary ceco-colic stasis seems to be a rare condition as it occurred in less than 1 per cent of our cases. Schlesinger reports similar findings. Cecal non-stasis occurred in 57 per cent of our series. (For further details see Table 1.)

*Sex.* In cecal stasis, and particularly in ceco-colic stasis, the number of females exceeded that of males by about 5 to 4 and 3 to 2 respectively. These findings are in keeping with the greater incidence of low cecum in females (see the second article of this series).

*Habitus.* This did not seem to play much of a rôle, except possibly for a very slight preponderance of asthenics over sthenics in our cases of secondary ceco-colic stasis.

TABLE I  
PROXIMAL COLON STASIS

Incidence of Various Forms	Cases	Per cent
Cecal non-stasis	547	57.1
Cecal stasis		
Cecal stasis proper (48 hours or more)	265	27.5
Twenty-four hour cecal stasis	38	3.9
Ceco-colic stasis		
Secondary ceco-colic	98	10.0
Primary ceco-colic	8	0.8
Primary 24 hour ceco-colic	3	0.4
Total	959	99.7

#### THE CLINICAL PICTURE OF PROXIMAL COLON STASIS

The symptoms associated with stasis in the proximal colon may be divided into

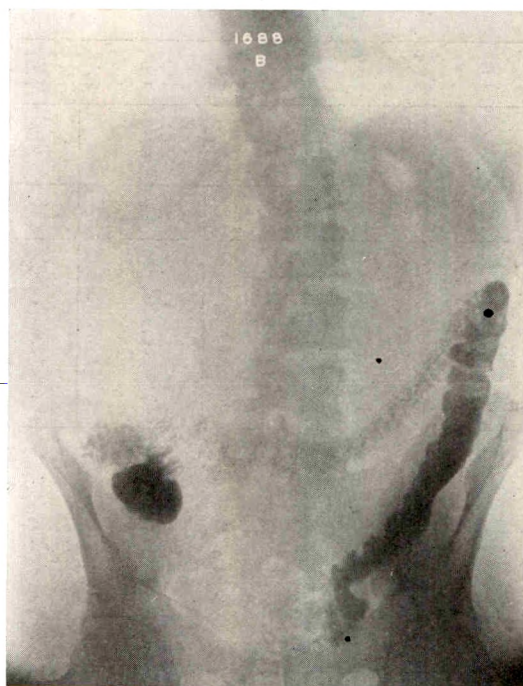


FIG. 12. Ceco-colic sphincter spasm. Appearance after evacuation of opaque enema (a common finding). Same case as Figure 11.

two groups, local and general. The most prominent local symptoms are pain and tenderness in the right lower quadrant. The pain is dull, dragging in character, and often constant in occurrence. Fever and rigidity are not present. A palpable, spastic or gurgling ceco-colon is a common objective finding. Ileal stasis occurs fairly

The only symptoms of a general nature that were subjected to analysis in the present study are headache and vomiting. Both of these are increased in proximal colon stasis. Other less tangible reflex or toxic effects have not been studied by us. In the literature one finds statements that such conditions as thyroid enlargement

TABLE II  
RELATION OF CECAL POSITION TO PROXIMAL COLON STASIS

	Position of Cecum					
	Low		Normal		High	
	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent
In 1226 unselected cases (general incidence)...	241	19.6	933	76.1	52	4.3
In 547 cases of cecal non-stasis.....	82	14.9	432	79.0	33	6.0
In 265 cases of cecal stasis.....	61	23.1	190	71.6	14	5.3
In 38 cases of 24 hour cecal stasis.....	5	13.1	30	79.0	3	7.9
In 98 cases of secondary ceco-colic stasis.....	33	34.0	63	63.9	2	2.1

Relation of Proximal Colon Stasis to Cecal Position

Incidence of	In 153 Low Ceca		In 217 Normal Ceca		In 35 High Ceca		General Incidence (for comparison)
	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Per Cent
Cecal non-stasis.....	68	44.4	131	60.3	22	62.8	57.1
Cecal stasis.....	54	35.2	59	27.1	9	25.7	27.5
Twenty-four hour cecal stasis.....	4	2.6	11	5.1	2	5.7	3.9
Secondary ceco-colic stasis.....	27	17.6	16	7.3	2	5.7	10.0

often with cecal stasis. Whatever may be the nature of the original association between cecal stasis and appendicitis it is quite clear that appendectomy does not relieve the former condition, though it may improve the symptoms. Constipation is common of course in secondary ceco-colic stasis. Diarrhea is not frequently encountered except in the twenty-four hour cecal stasis group.

(Behan), idiopathic epilepsy (Armstrong), and dementia precox (Holmes and Retinger) are intimately associated with proximal colon stasis. In our series, the incidence of thyroid enlargement was not appreciably above the average, and as far as we know, there was only one case of epilepsy and none of dementia precox among these patients.

The cause of the symptoms in proximal



colon stasis will be discussed in a subsequent section.

*Relation of Proximal Colon Stasis to Cecal Position.* The incidence of cecal stasis and particularly of secondary ceco-colic stasis was considerably greater in low than it was in normal or high ceca. Low ceca, conversely, occurred more often in cecal stasis (23 per cent) and in ceco-colic stasis (34 per cent) than in a large series of unselected cases in which the incidence was 19 per cent. Although the above figures seem to lend some support to the general impression that the lower the cecum, the greater the difficulty in emptying the proximal colon, nevertheless, it must be pointed out that the incidence of cecal non-stasis is still relatively high in low ceca,—to be exact, 44 per cent as against 60 and 61 per cent in normal and high ceca respectively. In other words, the emptying of the cecum is fairly effective despite its low position. It is well to keep these findings in mind, because

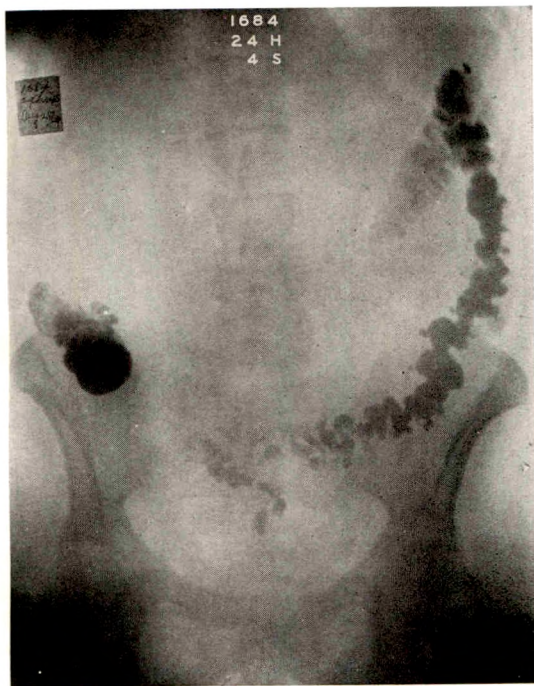


FIG. 13. Cecal stasis due to angulation of ascending

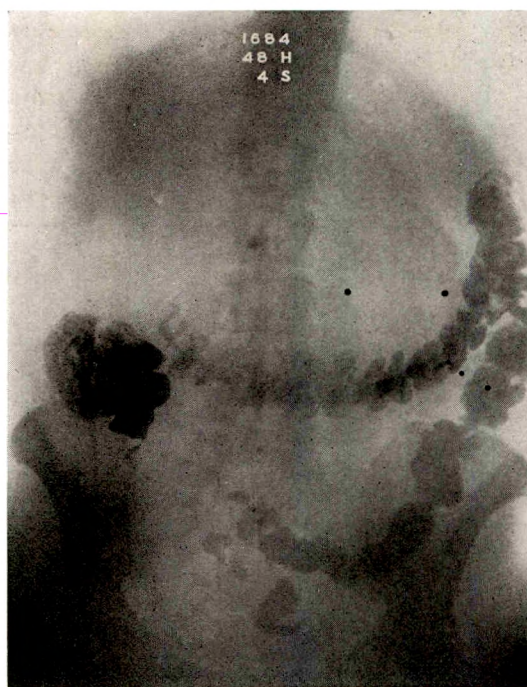


FIG. 14. Cecal stasis due to angulation of ascending colon. Appearance 48 hours after opaque meal; four stools. Same case as Figures 13, 15 and 16.

as we hope to show later, it is the position of the cecum rather than stasis within the proximal colon that appears to be responsible for at least some of the symptoms in these cases.

*Relation of Proximal Colon Stasis to Constipation.* Stierlin has pointed out that proximal colon stasis is a cause of constipation, i.e., fecal retention in the distal colon. As far as our figures are concerned (see Table III) this cannot be denied, because there is the same relative increase in the incidence of ceco-colic stasis in constipation as there is of constipation in ceco-colic stasis. It is possible, however, that we may be dealing with a vicious circle in which the primary condition is the constipation, and that this produces a proximal colon stasis which, in turn, accentuates the constipation. On the other hand, a striking feature in many cases is the persistence of a residue in the cecum despite the regular passage of one



for the better part of a week (Figs. 5, 6 and 7).

TABLE III  
RELATION OF CONSTIPATION TO  
PROXIMAL COLON STASIS

Incidence of Constipation	Cases	Per Cent
In 947 unselected cases (general incidence).....	522	55.1
In 547 cases of cecal non-stasis...	282	51.5
In 264 cases of cecal stasis.....	150	56.8
In 38 cases of 24 hour cecal stasis	17	44.7
In 98 cases of secondary ceco-colic stasis.....	73	74.4

RELATION OF PROXIMAL COLON STASIS  
TO CONSTIPATION

Incidence of	In 455 Cases of Constipation		General Incidence (for comparison)
	Cases	Per Cent	Per Cent
Cecal non-stasis	247	54.2	57.1
Cecal stasis.....	130	28.5	27.5
Twenty-four hour cecal stasis.....	16	3.5	3.9
Secondary ceco-colic stasis.....	62	13.6	10.0

*Relation of Proximal Colon Stasis to Colitis.* As might be expected, the more marked and extensive the stasis in the proximal colon, the less marked was the irritability of the colon as expressed in the syndrome of colitis, the roentgen characteristics of which were given in a previous paper. Thus, colitis was encountered least often in the secondary ceco-colic stasis group and most often in the twenty-four hour cecal stasis cases (see Table IV).

In this connection it may be interesting to note that certain authors (de Martel and Antoine, Harvier, Roux, Hurst) have pointed out that in cecal stasis a period of constipation may terminate in a "diarrheal debacle" characterized by eight or ten stools in twenty-four hours. In our series of cases, diarrhea in general showed the same incidence as colitis, namely, it was

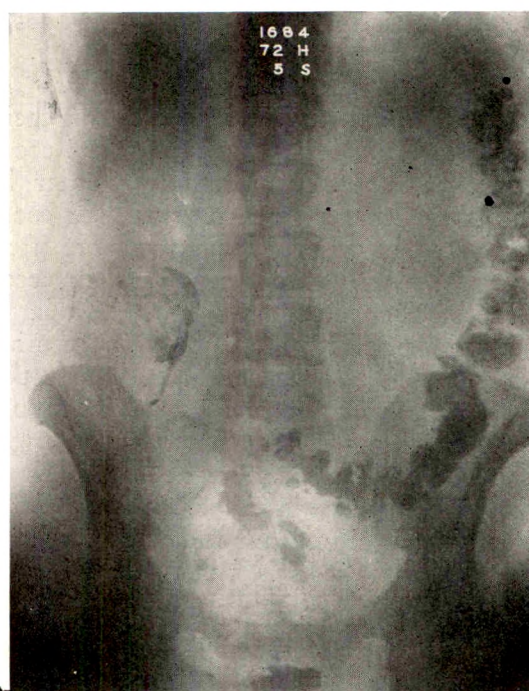


FIG. 15. Cecal stasis due to angulation of ascending colon. Appearance 72 hours after opaque meal; five stools. Same case as Figures 13, 14 and 16.

TABLE IV  
RELATION OF COLITIS TO PROXIMAL COLON STASIS

Incidence of colitis	Cases	Per Cent
In 934 unselected cases (general incidence).....	371	39.7
In 536 cases of cecal non-stasis..	233	41.6
In 263 cases of cecal stasis.....	102	38.7
In 37 cases of 24 hour cecal stasis	19	51.3
In 98 cases of secondary ceco-colic stasis.....	27	27.5

RELATION OF PROXIMAL COLON STASIS TO COLITIS

Incidence of	In 297 cases of colitis (with 9 hour observation)		General Incidence (for comparison)
	Cases	Per Cent	Per Cent
Cecal non-stasis in	169	61.6	57.1
Cecal stasis in....	73	26.6	27.5
Twenty-four hour cecal stasis in...	12	4.3	3.9
Secondary ceco-colic stasis in....	20	7.3	10.0



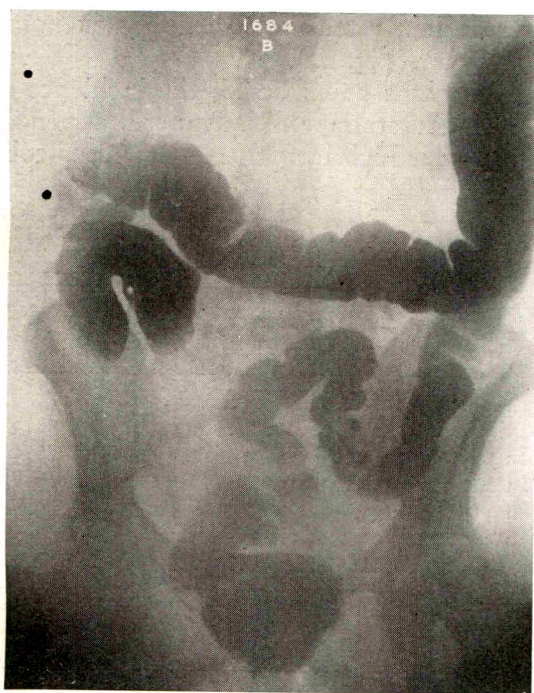


FIG. 16. Cecal stasis due to angulation of ascending colon. Appearance after opaque enema. Same case as Figures 13, 14 and 15.

not at all prominent in either cecal or ceco-colic stasis, but showed about a 33 per cent increase in incidence in twenty-four hour cecal stasis.

*Relation of Proximal Colon Stasis to Ileal Stasis.* Since ileal stasis occurs distinctly more often in cecal stasis than in ceco-colic stasis, it seems fair to assume an intimate relationship between cecal stasis and ileal stasis (see Table v). A possible explanation of this interesting association is that both conditions (cecal stasis and ileal stasis) are due to spasticity of the ceco-colic sphincteric tract.

- In a previous paper, the rôle of ileocecal sphincteric spasm in the production of ileal stasis was emphasized. To this factor in the etiology of ileal stasis must now be added spasm of the ceco-colic sphincter, a concept which we owe to the painstaking investigations of Hirsch.

*Relation of Proximal Colon Stasis to Right Lower Quadrant Pain and Tenderness.* Right lower quadrant pain occurs one

TABLE V  
RELATION OF ILEAL STASIS TO PROXIMAL COLON STASIS

Incidence of Ileal Stasis	Cases	Per Cent
In 500 unselected cases (general incidence).....	257	51.4
In 296 cases of cecal non-stasis..	148	50.0
In 132 cases of cecal stasis.....	81	61.3
In 26 cases of 24 hour cecal stasis	8	30.8
In 46 cases of secondary ceco-colic stasis.....	20	43.4

RELATION OF PROXIMAL COLON STASIS  
TO ILEAL STASIS

Incidence of	In 257 cases of ileal stasis		General Incidence (for comparison)
	Cases	Per Cent	Per Cent
Cecal non-stasis...	142	55.9	57.1
Cecal stasis.....	78	30.7	27.5
Twenty-four hour cecal stasis.....	8	3.1	3.9
Secondary ceco-colic stasis.....	26	10.2	10.0

and one-half times as often in cecal stasis as it does in secondary ceco-colic stasis and vice versa (see Table vi). On the other hand, right lower quadrant tenderness occurs about one-fourth more often in secondary ceco-colic stasis than it does in cecal stasis (see Table vii). We have no explanation to offer for this interesting dissociation unless it be that pain (subjective) is more likely to be associated with spasm of the ceco-colic sphincter, and tenderness (objective) with a low position of the cecum.

*Relation of Proximal Colon Stasis to Headache and Vomiting.* Although headaches and vomiting occurred more often in both cecal and ceco-colic stasis than in the general series, these symptoms were particularly associated with retention in the ceco-colon rather than in the cecum alone (see Table viii). It will be recalled (see second study of this series) that both headache and vomiting are closely associated with a low cecum. As already

mentioned, and as we hope to show later, it is possibly the low position of the cecum rather than the retention within the ceco-colon that is responsible for the symptoms in the present series.

TABLE VI  
RELATION OF RIGHT LOWER QUADRANT PAIN  
TO PROXIMAL COLON STASIS

Incidence of right lower quadrant pain	Cases	Per Cent
In 945 unselected cases (general incidence).....	127	13.5
In 545 cases of cecal non-stasis..	57	10.4
In 265 cases of cecal stasis.....	52	19.6
In 38 cases of 24 hour cecal stasis	5	13.1
In 97 cases of secondary ceco-colic stasis.....	13	13.4

RELATION OF PROXIMAL COLON STASIS TO  
RIGHT LOWER QUADRANT PAIN

Incidence of	In 127 cases of right lower quadrant pain		General Incidence (for comparison)
	Cases	Per Cent	Per Cent
Cecal non-stasis...	57	44.8	57.1
Cecal stasis.....	52	40.9	27.5
Twenty-four hour cecal stasis.....	5	3.9	3.9
Secondary ceco-colic stasis.....	13	10.2	10.0

*Relation of Proximal Colon Stasis to Appendix Stasis and to Appendectomy.* A special investigation was made of appendix filling as demonstrated roentgenographically after a barium meal. As a preliminary, 396 cases were reviewed. Appendectomy had been previously performed in 93, or 23 per cent, of these. In the remaining cases, 58 per cent showed filling of the appendix with barium at some time after the opaque meal, each case being followed until the colon was clear. Forty-five per cent showed appendix stasis, as determined by retention of barium in this organ for forty-eight hours or more. Ten per cent showed advanced appendix

stasis, i.e., retention for ninety-six hours or longer (Fig. 20).

As might be expected, the incidence of appendix stasis and advanced appendix stasis was high in both cecal and ceco-colic

TABLE VII  
RELATION OF RIGHT LOWER QUADRANT TENDERNESS  
TO PROXIMAL COLON STASIS

Incidence of right lower quadrant tenderness	Cases	Per Cent
In 941 unselected cases (general incidence).....	267	28.3
In 544 cases of cecal non-stasis..	155	28.5
In 262 cases of cecal stasis.....	70	26.8
In 38 cases of 24 hour cecal stasis	10	26.3
In 97 cases of secondary ceco-colic stasis.....	32	33.0

RELATION OF PROXIMAL COLON STASIS TO RIGHT  
LOWER QUADRANT TENDERNESS

Incidence of	In 267 cases of right lower quadrant tenderness		General Incidence (for comparison)
	Cases	Per Cent	Per Cent
Cecal non-stasis...	151	56.5	57.1
Cecal stasis.....	74	27.7	27.5
Twenty-four hour cecal stasis.....	11	4.1	3.9
Secondary ceco-colic stasis.....	31	11.6	10.0

stasis, more particularly in the latter (see Table x) (Fig. 20). Conversely, the incidence of cecal stasis and especially ceco-colic stasis was relatively high in advanced appendix stasis (see Table xi). The incidence of appendectomy was slightly higher (28 per cent) in both cecal and ceco-colic stasis, than in the general series (23 per cent) (see Table x). On the other hand, the incidence of both cecal and ceco-colic stasis was slightly higher in appendectomized individuals than in those not operated on (see Table xii). The evidence therefore seems clear that appendectomy tends to increase rather than to relieve proximal colon stasis.



TABLE VIII

RELATION OF HEADACHES TO PROXIMAL COLON STASIS

Incidence of headache	Cases	Per Cent
In 947 unselected cases (general incidence).....	255	26.9
In 547 cases of cecal non-stasis..	140	25.5
In 265 cases of cecal stasis.....	74	27.9
In 38 cases of 24 hour cecal stasis	7	18.4
In 97 cases of secondary ceco-colic stasis.....	34	35.1

RELATION OF PROXIMAL COLON STASIS TO HEADACHES

Incidence of	In 258 cases of headache		General Incidence (for comparison)
	Cases	Per Cent	Per Cent
Cecal non-stasis...	141	54.6	57.1
Cecal stasis.....	75	29.0	27.5
Twenty-four hour cecal stasis.....	7	2.7	3.9
Secondary ceco-colic stasis.....	35	13.5	10.0

TABLE IX

RELATION OF VOMITING TO PROXIMAL COLON STASIS

Incidence of vomiting	Cases	Per Cent
In 948 unselected cases (general incidence).....	210	22.1
In 547 cases of cecal non-stasis..	108	19.7
In 265 cases of cecal stasis.....	64	24.1
In 38 cases of 24 hour cecal stasis	5	13.1
In 98 cases of secondary ceco-colic stasis.....	33	33.7

RELATION OF PROXIMAL COLON STASIS TO VOMITING

Incidence of	In 214 cases of vomiting		General Incidence (for comparison)
	Cases	Per Cent	Per Cent
Cecal non-stasis...	108	51.4	57.1
Cecal stasis.....	64	30.4	27.5
Twenty-four hour cecal stasis.....	5	2.3	3.9
Secondary ceco-colic stasis.....	33	15.7	10.0

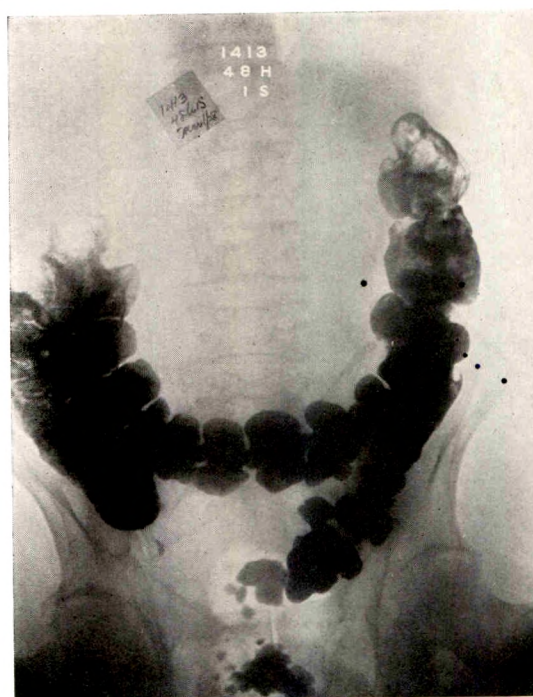


FIG. 17. Secondary ceco-colic stasis. Appearance 48 hours after opaque meal; one stool.

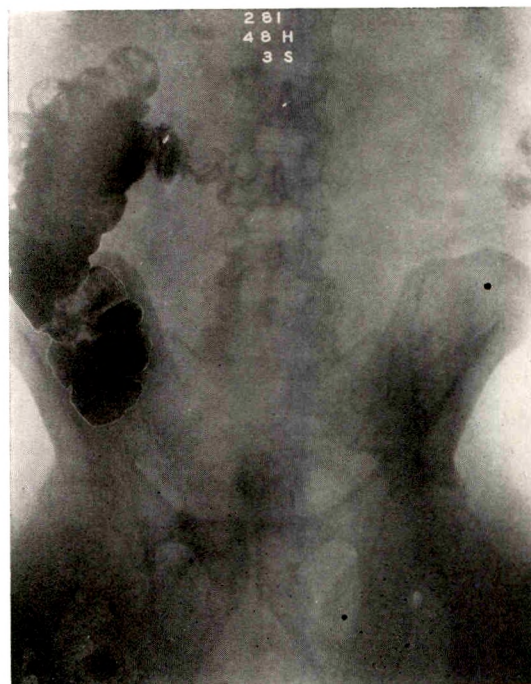


FIG. 18. Primary ceco-colic stasis. Appearance 48 hours after opaque meal; three stools.

TABLE X  
RELATION OF APPENDIX FILLING TO PROXIMAL COLON STASIS

	Incidence of Appendectomy		Number of Appendices Available for Filling	Incidence of Appendix Filling		Incidence of Appendix Stasis (48 hrs.)		Incidence of Advanced Appendix Stasis (96 hrs.)	
	Cases	Per Cent	Cases	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent
In 396 unselected* cases (general incidence)...	93	23.4	303	177	58.4	135	44.5	31	10.2
In 219 cases of cecal non-stasis.....	46	21.0	173	95	54.9	69	39.9	9	5.2
In 108 cases of cecal stasis.....	30	27.8	78	51	65.4	43	55.5	14	17.9
In 26 cases of 24 hr. cecal stasis.....	5	19.2	21	13	61.9	6	28.6	0	0
In 43 cases of secondary ceco-colic stasis.....	12	27.9	31	18	58.1	17	54.8	8	25.8

TABLE XI  
RELATION OF PROXIMAL COLON STASIS TO APPENDIX FILLING

Incidence of	In 379 Cases of Appendix Filling		In 104* Cases of Appendix Stasis		In 30 Cases of Advanced Appendix Stasis		General Incidence (for comparison)
	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent	Per Cent
Cecal non-stasis.....	203	53.5	59	56.6	10	33.3	57.1
Cecal stasis.....	108	28.4	29	27.9	14	46.7	27.5
Twenty-four hours cecal stasis.....	26	6.8	6	5.6	0	0	3.9
Secondary ceco-colic stasis.....	42	11.0	10	9.6	6	20.0	10.0

#### THE CAUSE OF SYMPTOMS IN PROXIMAL COLON STASIS

We are now in position to consider our third basic question: What is the mechanism of the symptoms in proximal colon stasis? Are they due entirely to absorption of toxins, as is generally assumed, or may some other factor be operative in their production?

Table XIII presents a synoptic review of certain general symptoms (headache, vomiting), and certain local symptoms and signs (right lower quadrant pain and tenderness). The uppermost line gives the general incidence of these conditions in a large series (over 1000) of unselected cases. In the lines below, the incidence of

these factors is distributed for cecal stasis and for ceco-colic stasis, respectively,

TABLE XII  
RELATION OF PROXIMAL COLON STASIS TO APPENDECTOMY

Incidence of	In 191 cases of Appendectomy		General Incidence (for comparison)
	Cases	Per Cent	Per Cent
Cecal non-stasis...	104	54.4	57.1
Cecal stasis.....	56	29.3	27.5
Twenty-four hour cecal stasis.....	7	3.6	3.9
Secondary ceco-colic stasis.....	24	12.5	10.0

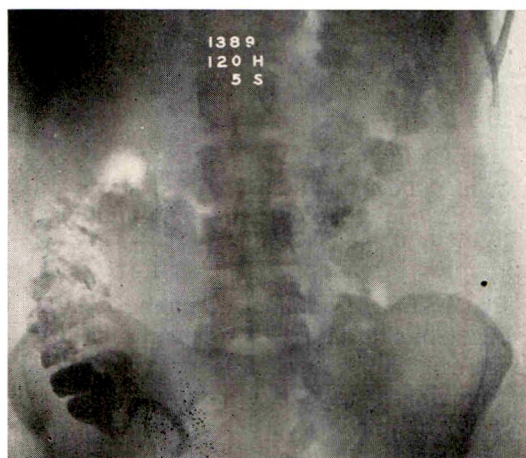
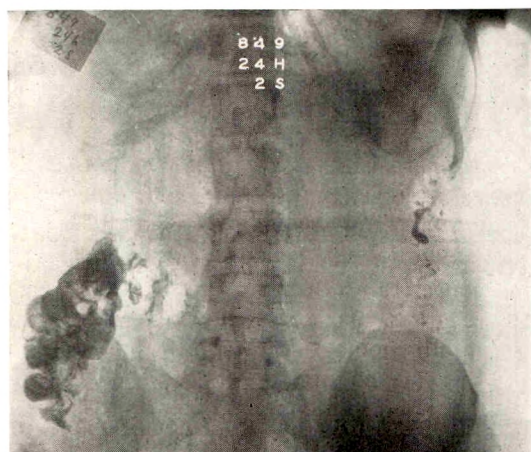
TABLE XIII

RELATION OF CERTAIN GENERAL AND LOCAL SYMPTOMS TO PROXIMAL COLON STASIS AND CECAL POSITION

	Headaches	Vomiting	Right Lower Quadrant Pain	Right Lower Quadrant Tenderness
	(per cent)	(per cent)	(per cent)	(per cent)
In unselected cases (general incidence.....)	25	19	13	28
low ceca.....	31	45	21	27
In cecal stasis    normal ceca..	26	17	18	27
high ceca....	21	14	14	14
low ceca.....	48	48	18	51
In secondary    normal ceca..	26	26	9	22
cecal stasis  high ceca....		Two cases only		

in regard to the position of the cecum, whether it be low, normal, or high,—except in the case of high cecum in cecocolic stasis, in which group only two cases were available. As is readily seen, the incidence of these symptoms and signs is from one and one-half to over two times as high in the low ceca group, as in the normal or high ceca.

The conclusion therefore seems permissible that the symptoms of proximal colon stasis may not be due to the stasis as such, for this should be equally operative no matter in what location it occurs, but that it is the position of the cecum that is the responsible factor. In other words, the phenomenon may not be intrinsic, but may be extrinsic as far as the





colon is concerned. Although the final solution is not yet at hand, one is strongly tempted to ask whether the symptoms associated with low cecum (and incidentally with proximal colon stasis) may not be produced much higher in the alimentary tract, namely in the duodenum, as a result of transient blocking of this organ by the intermittent dragging of an elongated ceco-colon. For an illuminating and more detailed exposition of this general viewpoint, Carslaw's recent paper should be consulted.

To be sure, some of the ill effects of proximal colon stasis may be due to the absorption of locally produced toxins. Nevertheless, it is well known that so long as the liver remains competent, it forms a very effective barrier between poisons known to arise in the intestine and the general circulation. Furthermore as has recently been shown by Wangenstein and Loucks, when such a powerful toxin as histamine is injected into the lumen of the normal intestine, the absorption of this substance is practically negligible. That the situation is otherwise when the gut is unusually permeable or when the liver or other defensive mechanism is impaired, is of course quite conceivable.

In short, although it must be admitted that the colon may be the seat of important changes of a bacterial, chemical, or metabolic nature, further precise information in this direction is extremely desirable. In our work to date we have disregarded this aspect of the problem in the pursuit of other possibilities.

#### THERAPY

The object of treatment is obviously to improve proximal colon emptying. This may be brought about by:

1. Relieving the constipation.
2. Relieving the ceco-colic spasm and irritation.
3. Fattening cure.
4. Surgical treatment.

Relieving constipation is desirable because it clears the track ahead and prevents back-fire into the cecum. In at least 10 per cent of the cases—namely, those with secondary ceco-colic stasis—this may be all that is necessary to achieve a cure. In general, the gentlest measures are the safest. Irritating irrigations and violent purges should be avoided. Restoration of normal colon function is best achieved by such conservative procedures as rest, smooth diet, and adequate water drinking. If drugs appear indicated, lubrication with emollients from above and below should first be attempted. If this is inadequate, an infusion of senna pods, which is said by Stierlin to have a specific effect in emptying the ceco-colon, may be prescribed in gradually decreasing dosage. Castor oil at weekly intervals is sometimes well tolerated. In other cases, a series of gentle but thorough colonic irrigations may remove old residues and start spontaneous and more effective bowel action. Theoretically the best form of irrigation would be that in which the cecum is directly tapped and lavaged. Although many attempts have been made at cecal intubation, the difficulties are great and in many cases, insurmountable. A very fair presentation of the technical skill involved is that by Hoff.

Relief of ceco-colic spasm implies treatment of its cause. If there is local organic disease this must be removed if possible. Otherwise one must realize that much irritation may result from dietary factors. Proteins are said to cause intoxication from the intermediary or end products of their digestion (Roux). Cellulose-rich vegetables such as radishes, celery, and legumes are broken down by bacterial action in the ceco-colon with much gas production. Accordingly, the "soluble" proteins such as eggs, should be entirely omitted from the diet as well as raw vegetables (salads) and raw fruit, and in most cases, raw whole milk. Well-cooked meat may be allowed in small amounts. Spa-

ghetti, rice and potatoes are well tolerated.

In order to control "intestinal putrefaction" by changing the bacterial flora, the best results are obtained from the use in adequate amounts of acidophilus milk with the addition of lactose.

As in similar conditions elsewhere in the body, the general treatment for spasmodophilia is here applicable, namely, rest, hot fomentations, general sedatives and the antispasmodics.

A fattening cure is very frequently useful when proximal colon stasis occurs in asthenics who are undernourished. The relief of symptoms from improving the nutrition is explained by the added support given the ptotic organs by increasing the mesenteric and peritoneal fat deposits. These in turn help overcome strain on important nerve pathways and promote the circulation.

If the above conservative measures fail in obtaining relief, surgical therapy may be considered. So far, we have had no experience with this form of treatment. Various procedures have been advocated, namely, division of pericolic membranes, cecoplication and ceco-colic fixation, short-circuiting by ceco-sigmoidostomy, and even resection of the right colon. At the present time the various forms of fixation of the ceco-colon seem to be the most popular procedures, Waugh having reported on 180 such operations, Quain on 52, Carslaw on 242, and Houston on 145. In view of the good results claimed for such conservative surgery, one would hesitate to recommend the more radical procedures (such as short-circuiting and resection). Finally, in the present state of our knowledge, it seems only proper to insist on a thorough trial of medical treatment, a careful selection of cases for surgical therapy, and their rigid control by appropriate pre- and post-operative study.

#### SUMMARY

1. Cecal stasis proper occurred in 27 per cent of 959 carefully studied gastro-

intestinal cases. Its chief clinical associations are with low cecum (slight), right lower quadrant pain (fairly marked), ileal stasis (fairly marked), and appendix stasis (fairly marked). Appendectomy does not diminish the incidence of this condition.

2. Ceco-colic stasis occurs rarely (less than 1 per cent) as a primary condition. When associated with constipation (stasis in the colon distal to the hepatic flexure) its incidence is 10 per cent. In this form its chief clinical associations are with low cecum (fairly marked), right lower quadrant tenderness (slight), constipation (very marked), vomiting and headache (marked), and advanced appendix stasis (marked). Appendectomy does not diminish the incidence of this condition.

3. Cecal stasis is a condition of relatively minor importance. Ceco-colic stasis when associated with constipation is more likely than cecal stasis to give symptoms of clinical significance. Ceco-colic stasis in its primary form (i.e., not associated with constipation) is encountered so seldom that its clinical meaning cannot as yet be established by the statistical method employed in these studies.

4. Neither cecal stasis nor ceco-colic stasis seems capable in itself of causing disorders of marked clinical importance. Thus, when these forms of retention occur in the presence of normal or high ceca, symptoms are relatively uncommon. When they occur in the presence of a low placed cecum, symptoms are much more frequent. This evidence seems to favor the view that the symptomatology in many of these cases may be due to the effect of the colon dragging on adjacent organs (possibly the duodenum) rather than to absorption from within the proximal large intestine.

5. It seems reasonable to conclude from this investigation that the treatment of right colon stasis should be directed primarily toward the restoration of colon function by such procedures as the re-

lief of constipation, by antispasmodics, and by fattening the patient. If such conservative measures fail, it is possible that surgical intervention may prove useful. Appendectomy is definitely worthless as far as correcting cecal stasis is concerned. The release of constricting bands and some form of ceco-colic elevation or fixation

are procedures that appear worthy of consideration. These suggestions, however, are as yet theoretical, as we have had no personal experience with surgical therapy. Careful selection of cases and control by pre- and postoperative study are most desirable in the present stage of our knowledge.

## REFERENCES

1. ARMSTRONG, G. E. Relation of caecum-ascending colon content to idiopathic epilepsy. *Practitioner*, 1926, 117, 288-291.
2. BASSLER, A., and LUTZ, J. R. Caput puddling. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1922, 9, 517-518.
3. BEHAN, R. J. Cecal stasis and its relationship to appendicitis. *Penn. M. J.*, 1920, 24, 130-135.
4. BENSAUDE, R., GUÉNAUD, G., and CONSTANTIN, P. L'examen radiologique dans la constipation habituelle. *J. méd. franc.*, 1919, 8, 255-272.
5. CARNOT, P., HARVIER, P., FRIEDEL, R., and LARDENNOIS, G. Consultations sur les maladies de l'estomac et de l'intestin: les colites. J.-B. Baillière & Fils, Paris, 1923.
6. CARSLAW, R. B. Right-sided visceroptosis. *Brit. J. Surg.*, 1928, 15, 545-604.
7. CASE, J. T. X-ray observations on colonic peristalsis and antiperistalsis, with special reference to the function of the ileocolic valve. *Med. Rec.*, 1914, 85, 415-427.
8. CASE, J. T. A roentgenologic study of pain in the right lower abdomen. *Bull. Battle Creek San. & Hosp. Clin.*, 1922, 18, 89-97.
9. COFFEY, R. C. The principles underlying the surgical treatment of gastro-intestinal stasis, due to causes other than strictural or ulcerative conditions. *Surg., Gynec. & Obst.*, 1912, 15, 365-429.
10. COFFEY, R. C. Gastro-enteroptosis. D. Appleton & Co., New York, 1923.
11. CUNNINGHAM, T. D. Stasis in the ascending colon simulating chronic appendicitis. *Radiology* 1925, 5, 480-485.
12. DESMAREST, E., and MERCIER, O. Vingt cas de résection du colon droit pour stase cécale. *Presse méd.*, 1924, 32, 925-927.
13. DUROUX, E. Stase intestinale et péricolites droites. *Presse méd.*, 1927, 35, 1569-1572.
14. DUVAL, P., and ROUX, J.-C. La stase stercorale caeco-ascendante et son traitement chirurgical. *Arch. d. mal. de l'appar. digest.*, 1919-1920, 10, 705-744.
15. GRAY, H. M. W. Effects of stagnation in the ascending colon. *Canad. M. Ass. J.*, 1924, 14, 93-100.
16. HIRSCH, I. S. The cecocolic sphincteric tract. *Med. J. & Rec.*, 1924, 119, 541-549.
17. HOFF, H. C. Retrograde intubation of the caecum. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1928, 20, 226-232.
18. HOLMES, B., and RETINGER, J. Dementia precox studies; the relation of cecal stasis to dementia precox. *Med. Rec.*, 1916, 89, 815.
19. HOUSTON, W. R. Mobile right colon. *J. Am. M. Ass.*, 1929, 93, 766-768.
20. HURST, A. F. Constipation and Allied Intestinal Disorders. Second edition. H. Frowde, London, 1919, pp. 260-268.
21. JORDAN, A. C. Chronic Intestinal Stasis (Arbuthnot Lane's Disease); A Radiological Study. H. Frowde, London, 1923.
22. KEITH, ARTHUR. The functional nature of the caecum and appendix. *Brit. M. J.*, 1912, 2, 1599-1602.
23. KLOSE, H. Klinische und anatomische Fragestellungen über das Coecum mobile. *Beitr. z. klin. Chir.*, 1909, 63, 711-741.
24. KLOSE, H. Das mobile Coecum mit seinen Folgezuständen und die chirurgische Behandlung ptotischer Erkrankungen des Magendarmkanales. *Beitr. z. klin. Chir.*, 1911, 74, 593-714.
25. KÖHLER, ALBAN. Röntgenology. William Wood, New York, 1928.
26. DE MARTEL, T., and ANTOINE, E. Pseudo-appendicitis. F. A. Davis Co., Philadelphia, 1925.
27. QUAIN, E. P. Pathogenic ptosis of the right colon. *Arch. Surg.*, 1923, 6, 638-652.
28. QUAIN, E. P. Contribution to the diagnosis and treatment of right coloptosis and its complications. *Am. J. Surg.*, 1924, 38, 193-198.
29. ROUX, J.-C. Constipation caecale entretenue par des adhérences au niveau de l'angle droit du colon. *Arch. d. mal de l'appar. digest.*, 1910, 4, 256-263.
30. SCHLESINGER, E. Die Roentgendiagnostik der Magen- und Darmkrankheiten. Second edition. Urban & Schwarzenberg, Berlin, 1922.
31. STIERLIN, E. Ueber die Obstipation von Aszendenstypus. *München. med. Wchnschr.*, 1911, 58, 1906-1911.

32. STIERLIN, E., and CHAUL, H. Klinische Röntgendiagnostik des Verdauungskanal. Second edition. Julius Springer, Berlin, 1928.
33. WALTON, A. J. Clinical aspects of visceroptosis. *Brit. J. Surg.*, 1915-1916, 3, 185-218.
34. WANGENSTEEN, O. H., and LOUCKS, M. Studies in intestinal obstruction. II. Absorption of histamine from obstructed bowel. *Arch. Surg.*, 1928, 16, 1089-1111.
35. WAUGH, G. E. The morbid consequences of a mobile ascending colon, with a record of 180 operations. *Brit. J. Surg.*, 1920, 7, 343-383.
36. WILMS. Das Caecum mobile als Ursache mancher Fälle von sogenannter chronischer Appendicitis. *Deutsche med. Wchschr.*, 1908, 34, 1756-1758.
37. WILMS. Fixation des Coecum mobile bei Fällen von sogenannter chronischer Appendicitis. *Centralbl. f. Chir.*, 1908, 35, 1089-1091.

## DISCUSSION

DR. J. T. CASE, Battle Creek, Mich. I wish I might show Dr. Kantor's first slides again. Three or four of them I would like to comment upon. I would like the third one and then about the eighth or ninth which calls for twenty-four hour cecal stasis.

I am glad Dr. Kantor has seen fit to investigate this question of stasis in the colon. I am glad he did not fail to emphasize the fact that there is a physiological basis for the distribution of the colonic residues, but I cannot quite agree with him that it is normal for the colon to require forty-eight hours for emptying. Even if it were normal, it is hard to see what provision of an economical nature would make it necessary for the body to retain the residues more or less for forty-eight hours after the greater portion of the meal has been abstracted during the eight hours it consumes in passing through the stomach and small intestine.

We all have seen the mass movements which take place in the colon and we know that the distribution of colonic residues has an important bearing or dependence upon recent mass movement. For instance, in this slide which I have asked Dr. Kantor to show again, we see what looks like residues accumulating in the rectum and lower sigmoid and then naturally piling up along the sigmoid toward the splenic flexure, with here a vacant space which does not mean spasm but merely the normal appearance after a mass movement has passed by and left some residues in the colon.

Again in this next slide we see a typical appearance following mass movements. I have watched under the fluoroscope hours at a time in cases of this sort; and I have seen four or five mass movements appearing within a half hour previous to such a roentgenogram as this. For instance, the patient may have had an evacuation of a very small amount

of material. Following that evacuation there has been a readjustment of the contents of the colon. This readjustment is shown in this slide and the principal mass of the sigmoid content has slipped on down into the rectum itself, leaving this characteristic appearance in the iliac colon; and then after a few minutes, another movement occurred and brought material from the bowel higher up down to this point, and it also seems that there was a mass movement which began over in the cecum. I have often wondered whether they should begin at the tip of the cecum or at the cecocolic sphincter. In my observations, they usually begin at about the ileocecal junction and push the material distalwards into the left half of the colon.

As you know, during these mass movements there are no haustral markings to be seen in the segment under motion. When the mass movement has come to an end, the haustral markings re-appear. Taking this next slide just as it is, there has been a recent mass movement from this part on; then within fifteen or twenty minutes after this film was made, the mass movement apparently emptied the cecum itself.

I just want to emphasize the fact that it is almost impossible to interpret many colonic films without knowledge of the hours at which the bowel movements had occurred in the particular case and something more or less as to the efficiency of those movements. We also, as Dr. Kantor very well brought out, need to know what surgery has been done, and in talking of any individual case where cecal stasis appears to be present, it is well to know whether or not the appendix has been removed. It is very interesting to me to know that he found twenty-three and a fraction per cent had had appendectomy. In counting over 2000 successive entries at the Battle

Creek Sanitarium, I found that just 25 per cent had had the appendix removed. That was fifteen years ago.

I was interested the other day in having one of our colleagues, Dr. Eggleston, report a series of cases of colitis in which he found that 26 per cent had had the appendix removed, so it seems to me the proportion of appendectomies in this country has reached a stabilized level and apparently the surgeons are removing about one-fourth of the appendices.

I would like to repeat that I think we should take into careful account this question of the physiology of the colon and it might be well to recall here the old classification given out many years ago by our friends in Germany and Austria relative to the types of constipation. We see relatively few cases nowadays of the so-called atonic constipation, that is, truly atonic constipation. Most people have either the hypertonic or the spastic type of constipation as we now call it, which shows a tendency to stasis in the proximal colon, and we see the mixed type where we have atonicity of the cecum, colon, and of the rectum itself and hypertonicity or spasticity of the intervening portions. As I say, the purely atonic constipations are very rare.

It all shows us that many of the appendectomies for so-called chronic appendicitis which have been done, have been done under a mistaken idea. The thing which causes the pain in the right side in these chronic cases is not the appendix itself but it is the stasis in the cecum. This distention can often be made to reproduce the pain by giving the patient a barium enema or by distending the colon.

DR. SHERWOOD MOORE, St. Louis, Mo. I should like to ask Dr. Kantor in what type of individual he finds cecal stasis, i.e., what is their general physical makeup, and also if he has definite views on the relationship of these redundancies and low positions of the

cecum and other segments of the colon to the habitus of the patient.

DR. KANTOR, (closing). To answer the last question first, Dr. Moore, the habitus figures appear in a table in the paper but they were not considered sufficiently interesting to present on the screen. Cecal stasis, like low cecum, predominates slightly but very definitely in asthenic people, and particularly in asthenic women.

I don't believe the evidence would support the conclusion that the lowness of the cecum is a result instead of being a cause of the phenomena in question, and for this reason, although it is possible that in some cases the colon will elongate as a result of chronic constipation or distal colon obstruction, the evidence now I think is preponderant to the effect that this is all a congenital business. This is proved by studies made on fetuses and by Larrimore of St. Louis on infants within one day and again within one month after birth—he gave enemas to these subjects to study the shape of the colon and found that the incidence of what we claim are anomalies throughout this whole work is almost identical with that of any other age group.

Dr. Case has pressed a point about the normal standard of colon emptying. Naturally Dr. Case and I who agree 99 per cent of the way cannot be expected to agree 100 per cent. His institution supports the theory, is based on the theory, succeeds on the theory, let us say, that one should be a vegetarian and that one should have three bowel movements a day, and all we say to that is it works all right in Michigan, but it doesn't seem to work in New York, and our figures are based on the individuals that we see here. We believe that all of you here are more likely to have a residue at forty-eight hours after the meal than you are to get rid of it in twenty-four.





## THE INTERPRETATION OF SINUS ROENTGENOGRAMS\*

By G. W. GRIER, M.D.

PITTSBURGH, PENNSYLVANIA

THE roentgen ray as a diagnostic aid in disease of the nasal accessory sinuses has been in general use for at least fifteen years. During this period there has probably been less improvement in the method than in any other field of roentgen diagnosis. This seems strange as there are no basic fundamental obstacles to the method such as in roentgen diagnosis of gall-bladder disease, for instance.

The accuracy of abdominal diagnosis in this period has increased remarkably because we have expended time and effort in studying abdominal pathology and make our examinations with great care, using an elaborate technique and repeating our processes with endless detail. To obtain the same accuracy in diagnosis, a roentgen study of the accessory sinuses should be made as carefully and with as much attention to detail. This involves:

1. Negatives of the greatest possible technical excellence.
2. The use of standard angles of exposure which can be accurately reproduced.
3. Exposures at all possible angles, which includes at least three different angles in the posteroanterior projections.
4. A careful study of the negatives so produced.
5. A knowledge of the pathological changes incident to sinus disease.

Little time need be taken to discuss the first requisite, good films. These can be produced in any laboratory if sufficient pains are taken to do so. The use of fine focus tubes, small diaphragms, and in my hands the Potter-Bucky diaphragm, has helped to improve the quality of sinus roentgenograms.

The use of standard angles cannot be stressed too strongly. I do not believe these angles can be guessed at, but think they

should be measured by whatever means the individual worker prefers.

I still use the apparatus previously described<sup>1</sup> which serves the double purpose of placing the vertical plane of the skull parallel with the film and also indicates accurate angles for the posteroanterior projections. These angles use a line from the external auditory meatus to the glabella as their base line. This line corresponds roughly with the floor of the frontal fossa of the skull. By selecting definite angles to this base line for standard posteroanterior projections, standard normals are set up and the films of one patient become comparable with others.

I have found stereoscopic posteroanterior views to be as great an aid in sinus interpretation as stereoscopic films are in chest diagnosis. However, in making these stereoscopic views, the tube must be shifted lengthwise of the patient's body and not crosswise.

If stereoscopic plates are not made, several posteroanterior views at different angles are still necessary as it often happens that pathology will be demonstrated at one of these angles and not at others. This occurs so often that too much emphasis cannot be laid upon the necessity for numerous exposures. The same statement applies to the superior-inferior view which I consider indispensable.

In addition to these views, I also make the Granger view for the sphenoids and the lateral view as routine. I occasionally use the Rhese view and believe it is valuable if one is familiar with the findings at this angle.

Having produced these films of excellent quality with accurate projections so that there is neither distortion nor obliteration by overlying shadows, time must be taken

\* Read at the Thirtieth Annual Meeting, American Roentgen Ray Society, New York City, Sept. 17-20, 1929.



FIG. 1. Mucocoele in right antrum.

to study them carefully for pathology. This cannot be done by glancing at the wet film.

The last requisite, a knowledge of sinus pathology as demonstrated by roentgen changes, is the real stumbling block in the progress of sinus diagnosis. The difficulties are increased because the roentgenologist and the rhinologist do not understand one another even when they attempt to cooperate.

The object of this paper is to attempt to find a common meeting ground for these two widely different viewpoints of sinus disease.

The recognition of sinus pathology depends upon variations in the normal transparency to roentgen rays of these air cavities. These areas of abnormal density may be partial or circumscribed; that is, they may occupy only a portion of one or more cavities; or they may be uniform, thus filling up or obliterating one or more of the sinus cavities.

The common lesions which produce circumscribed areas of density are as follows:

1. Benign tumors, such as osteoma or fibroma.
2. Polypi.
3. Mucocoele or cyst.
4. Hyperplasia of lining mucous membrane.

##### 5. Malignant new growth.

*Osteomata* are recognized by their marked density with sharply defined borders and continuity of structure with neighboring bony structures. They are probably without pathological significance as they are often seen in sinuses that seem to be otherwise normal. I have not been able to differentiate fibromata from polypi on the roentgenogram.

*Polypi*. Where these growths are not so numerous as to fill up the sinus and thus cause a general opacity, their contours can generally be made out as circumscribed shadows with smooth borders, round or pear-shaped, single or multiple. They are most easily recognized in the antrum or frontal sinus, with more difficulty in the ethmoids or sphenoids. They are difficult to differentiate from mucocoele or cyst.

These latter conditions are apt to be larger and are always round. If polypi can be seen in the nose, it is reasonable to assume that circumscribed growths in the sinuses with the appearance described are of a similar nature. The appearance of cavities filled with polypi will be described under general opacities.

*Mucocoele or Cyst*. These two cannot be

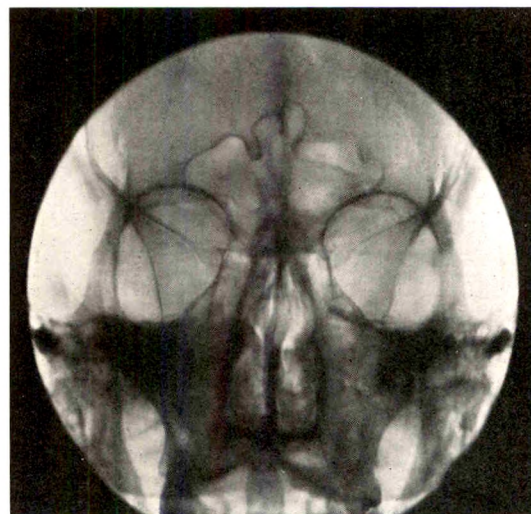


FIG. 2. Widening of both ethmoid regions characteristic of extensive polyposis.



differentiated from each other. The shadow is round and smooth, with well-defined borders, usually seen in the antrum, occasionally in the ethmoids. The condition is apt to be accompanied by a hyperplastic sinusitis. Occasionally, the contour of the growth can only be recognized in one of the several views; hence the necessity for a sufficient number of films.

In doubtful cases, injection of the sinus with lipiodol will usually demonstrate the lesion. However, while this procedure gives striking results, if the preliminary films are of the proper quality and show the detail they should, mucocoele will be demonstrated in most cases before lipiodol is injected.

*Hyperplasia of Lining Membrane.* The normal mucous membrane lining the sinuses is only a fraction of a millimeter thick. This membrane becomes thickened and fibrous as the result of chronic inflammation. This may accompany what is known as chronic hyperplastic sinusitis, where there is swelling and inflammation of the membrane with a clear exudate, either viscid or watery, but without pus. Or it may result from repeated attacks of purulent sinusitis with intervals of quiescence.

In either case, the membrane becomes thickened, sometimes up to a quarter of an inch, increased in density, with a sharply

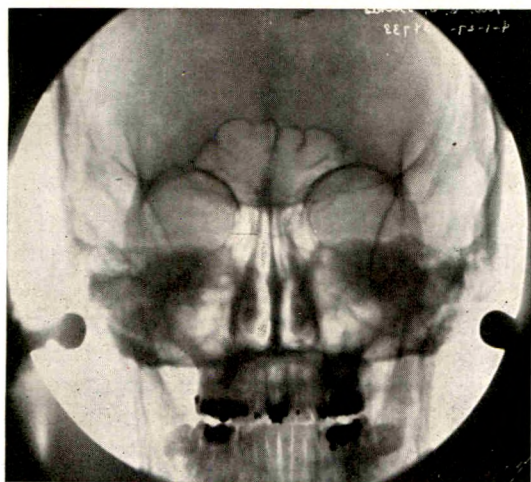


FIG. 3. Hyperplastic sinusitis in both antra and left ethmoids.

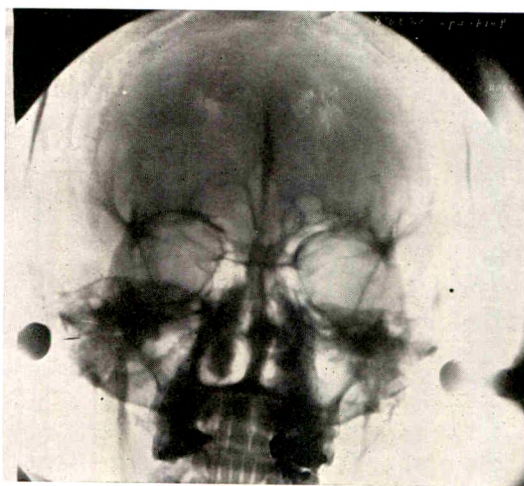


FIG. 4. Marked thickening of membrane in both antra from previous sinusitis, now inactive.

defined inner margin. This appearance can only be recognized in the antrum, or possibly the frontals, although I cannot recall having seen it in the latter location. If the process is old, healed and inactive, the membrane is unusually dense, the edge sharply circumscribed and the cavity decreased in size and clear. This state of affairs can usually be recognized without much question.

If the condition accompanies an active sinusitis, the inner margins of the membrane are apt to be fuzzy in appearance and the cavity somewhat blurred and opaque, probably from the presence of exudate.

Sometimes the roentgen changes as above described cannot be definitely classified and the differentiation must be made on history and physical examination. This the rhinologist can do if he is supplied with the proper interpretation of the roentgen findings.

If the condition is one of the recurring attacks of sinusitis and the roentgen examination happens to be made in an interval, or if the condition is old and healed, the roentgen findings will be positive and probably physical examination will fail to reveal pathology. Both the roentgenologist and the rhinologist should be conversant with this fact.



The thickening of the membrane is permanent and looks much the same in the roentgenogram: (1) whether the sinusitis is active; (2) during the interval between

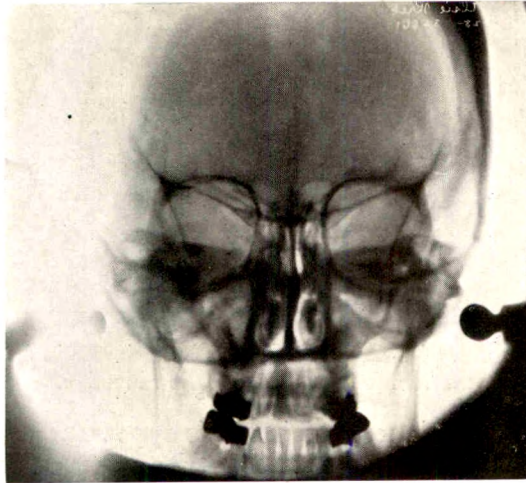


FIG. 5. Suppurative sinusitis in right ethmoids and right antrum with good drainage of the pus.

attacks in a recurring condition, even where this interval may be for long periods, or (3) in an old healed case where the attack may even be forgotten.

However, it is a fallacy to assume that this thickening of the membrane follows attacks of sinusitis in every case, as I have seen many cases both of chronic suppurative sinusitis and acute empyema of the antrum which have recovered without leaving any recognizable changes in the sinuses at all.

This does not apply to postoperative cases where the sinuses have been opened and the membrane curetted, or otherwise traumatized. These cases are always more or less opaque afterward, sometimes showing a definite edge of a thickened membrane and sometimes being generally blurred and opaque.

*Malignant New Growth.* The appearance depends on the nature and extent of the new growth. In sarcoma of the bones around the sinuses, the cavities are apt to be obliterated by the growth and the

character of the lesion determined by the bony changes.

In carcinoma of the nasal cavity, mouth, or membrane lining the antrum, with extension into the sinuses, the sinus cavity is also usually obliterated by the growth and by pus which results from secondary infection of the lesion. Under these circumstances, the true condition of affairs is usually easily determined by physical examination. If not, the only roentgen change suggestive of carcinoma is erosion or destruction of bone in the neighborhood of the lesion.

*General Opacities.* The underlying causes of this change are always difficult to differentiate and often one can only suggest the various pathological processes which might produce the appearance noted and leave it to the rhinologist to complete the diagnosis from the history and physical findings.

Where the opacity is very dense and uniform, completely blotting out the sinus cavity, the differentiation is usually not difficult as this appearance is only caused by empyema, extensive polyposis, or new growth.

The consideration of new growth has already been discussed.

Between empyema and polypi, the only difference in appearance known to me is a marked widening of the ethmoid regions in extensive polyposis, apparently due to a pushing out of the bony walls by these numerous growths. As these cases of extensive polyposis usually involve all the sinuses, this change is present in the ethmoids and can be detected.

If, as occasionally happens, the polypi are limited to one or both maxillary sinuses, this sign is of no avail.

However, it is easy for the rhinologist to differentiate between pus and polypi, as in the one instance he can see pus draining into the nose or throat; and in the other, polypi in all probability will be present in the nose as well as in the accessory sinuses. If the rhinologist would keep this in mind and not blame the roentgenologist for failing to make a differentiation which is



sometimes humanly impossible, there could be no necessity for an error in diagnosis between these two conditions.

It should be remembered that a suppurative sinusitis does not always result in an empyema of the involved cavity. If the drainage is free, the pus will discharge almost as fast as it forms and the only recognizable pathology under these circumstances will be the changes in the mucous membrane incident to the inflammation. I do not believe that these changes produce a dense uniform opacity such as we see where pus accumulates in the cavity.

In my experience a sinus filled with pus casts a much more dense shadow than any inflammatory change in the mucous membrane. The characteristic appearance of the latter is not a uniform opacity, but the circumscribed shadow seen around the sinus walls where the rays travel through the membrane edgewise. The cavity inside these "edges" may be slightly opaque or blurred, due to increased resistance to the rays offered by the thickened membrane as it presents a flat surface to the radiation, but it does not show the complete obliteration of the cavity seen in empyema of a sinus.

A fluid level in empyema of the antrum is an uncommon finding. If the drainage is good in a chronic suppurative condition, the cavity keeps fairly empty. If drainage is blocked, it soon becomes entirely filled. In either instance, there would not be a fluid level. In the event that drainage is interfered with to just that degree to result in a small amount of residual pus, this accumulates in the inferior angle and may be overlooked. This residuum is apt to present a concave upper border and be mistaken for the natural wall of the cavity. It will only be demonstrated if exposures are made in the sitting posture and if the beam of the rays happens to be projected parallel with the surface of the fluid.

Slight Uniform Opacities. This group includes all those cases in which there is a slight and uniform decrease in the normal

transparency of one or more cavities, often only recognized by careful comparison with the corresponding cavities on the other side. If both sides are affected, recognition

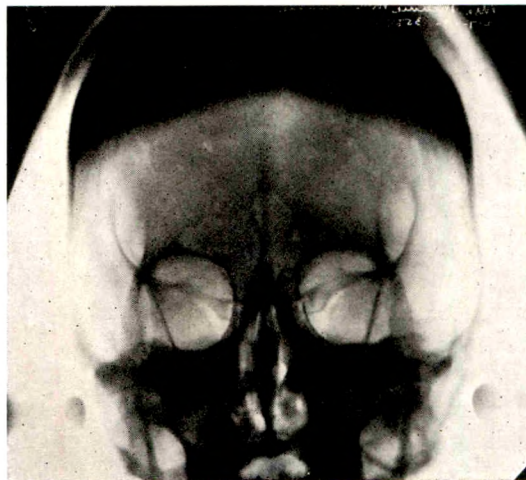


FIG. 6. Suppurative sinusitis in both ethmoids and both antra, with retention of pus.

is difficult and depends entirely upon the skill and experience of the one interpreting the negatives.

Improvements in technique have added somewhat to the difficulties since they have revealed changes not before recognized and the significance of these changes has not always been clearly understood.

In former times, the only pathology recognizable was so gross it could not be mistaken. The rhinologist has come to accept positive roentgen findings as meaning these gross changes. With the immensely superior films we are now able to produce, minor changes are demonstrated which have not at all the significance of the opaque sinuses of times past.

Slight uniform opacities of the sinuses are seen in the following conditions:

- ①. Congestion of mucous membrane as in acute colds or hay fever.
- ②. Slight thickening of the membrane left after recovery from a previous attack of sinusitis.
- ③. Following operations where the membrane has been traumatized.

4. Accompanying suppurative sinusitis where the pus is well drained out.
5. Chronic hyperplastic sinusitis.

It is obvious that the differentiation between these conditions cannot be made without information other than that obtainable from the roentgenogram.

If the patient has an acute cold one must, of course, be on his guard in interpreting slight opacities, especially of the antrum.

However, it must also be remembered that sinusitis not infrequently results from an acute cold, although when it does so, the drainage is usually impaired by the swollen mucous membrane, and an empyema of the antrum is most likely to occur. When drainage is reestablished and the cavity empties, resolution usually follows, or occasionally the condition may gradually develop into a chronic sinusitis.

In hay fever, congestion of the membranes of the sinuses may be present as it is in the nose, but here again one must remember that a chronic sinusitis, either of the suppurative or hyperplastic type, is occasionally the cause of hay fever.

Postoperative cases in which the sinuses have been opened and the membrane subjected to traumatism usually show a permanent opacity of some degree. A knowledge of the history is essential for recognition of this condition.

The three remaining conditions which commonly cause slight opacities are: (1) thickened membrane after recovery from sinusitis; (2) suppurative sinusitis with

free drainage; (3) chronic hyperplastic sinusitis.

The differentiation between these conditions is often impossible by roentgen examination. The antrum is probably the only cavity in which differentiation is ever possible.

Usually the healed case shows a thickened membrane with a sharply defined edge lining the walls of the antrum, with little decrease in the transparency of the cavity as a whole. Sometimes, however, the whole cavity is opaque.

In active suppurative sinusitis, a definite thickening of the membrane is not seen as commonly as in the other two conditions and if present, the edges are apt to be fuzzy and the whole cavity is usually slightly opaque.

In chronic hyperplastic sinusitis, the membrane is often quite thick, with fuzzy edges and a general opacity of the cavity.

The distinction between these three conditions is often quite impossible, but if the diagnosis can be narrowed down to them, the clinical differentiation is not difficult, as in the first instance the case is symptomless; the second shows pus draining into the nose or throat, and the third has symptoms of sinusitis either with a clear discharge, or without drainage.

In any roentgen report on the sinuses, all one can do is describe the findings, name the pathological conditions which give this appearance and state the one it most closely resembles. The final diagnosis can only be made with a knowledge of the history and physical examination.

#### REFERENCES

1. GRIER, G. W. Stereoscopy of the accessory sinuses. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1923, 10, 497-500.
2. GRIER, G. W. Roentgen diagnosis of disease in the nasal accessory sinuses. *Boston M. & S. J.*, 1925, 193, 50-66.

#### DISCUSSION

DR. SOLOMON FINEMAN, New York City. Dr. Grier is right in stating that the technique of sinus roentgenography is as difficult as anything we do in roentgenology. The most

painstaking attention to details is required for the production of fine sinus roentgenograms. Without such roentgenograms, roentgen diagnosis is practically impossible.

Rhinologists, as a class, are dissatisfied with sinus roentgenography. One of the many pitfalls in sinus roentgenography is insufficient care in placing the patient's head on the film. The skull is but seldom symmetrical. The roentgenologist therefore must project upon the film an imaginary, perfectly symmetrical skull placed with the utmost care in the various required positions. The slightest rotation of the head upon its vertical or horizontal axis is sufficient to produce misleading shadows and opacities. Erroneous interpretation, which naturally follows the reading of technically poor and misleading roentgenograms, is responsible, I believe, for the criticism of many rhinologists.

On the other hand, some of the differences of opinion between the roentgenologist and the rhinologist are due to a failure on the part of many rhinologists to recognize the fact which Dr. Grier has pointed out, that in sinus disease one often finds the catarrhal type in which the washings are clear, but which none the less shows very marked changes in the sinuses. •

Dr. Grier mentioned the recognition of polypi. As a rule, polypi can be detected readily on good roentgenograms. They are most frequently recognized in the antra. Occasionally they can be seen in the sphenoids or frontals.

The final point I wish to stress is that while sinus roentgenography is usually of very great aid to the rhinologist, instances occur in which for some reason or other the roentgen ray is unable to demonstrate pathologic changes when the clinical examination offers very positive evidence of such disease.

DR. F. M. LAW, New York City. I want to congratulate Dr. Grier on his very complete paper, so far as it went. It did not go far enough. He spoke of sinusitis as demonstrated by opacity. There is a different type of case that needs more help and that is the case in which there is no evident pathology as demonstrated to the roentgenologist. There are symptoms and there is reason to suspect a sinusitis but the roentgenologist sees apparently a fairly normal mucous membrane. This type of case occurs principally in cases of beginning blindness or in, as we have discovered lately, progressive deafness in children. In that particular type of case, the quality of roentgenogram that Dr. Grier spoke of is absolutely essential. I do not accept a film or plate unless the cancellous

structure of the bone is clearly visible and in which every distinct partition of the ethmoid capsule is clearly outlined. I feel that we are missing a great deal in diagnosis if we do not consider the character of the bony partitions of the ethmoid capsule. There are two types, one in which the ethmoid cells are swollen, the wall is fuzzy, and semitransparent; the other in which they are clear-cut and clean as though they had been drawn with a fine point pen. Those have been removed, and under the microscope bear out the roentgen appearance, one showing edema and the other a condensing otitis. In order to arrive at a diagnosis of that type of case, stereoscopic lateral exposures are necessary and thorough and complete study by someone who is expert in the use of the stereoscope. Not all roentgenologists see the stereoscopic images the same. This is particularly true of the ethmoids. With a properly made pair of stereoscopic plates of the ethmoids, you can distinguish the cellular structure on each side of the septum and if you will go over some of your films or plates with a knowledge of the history in view, and pick out the cellular structure, you will have a revelation in interpretation, and associate that with your clinical evidence, and you will give the rhinologist evidence that he has not thought possible.

DR. R. R. NEWELL, San Francisco, Calif. I want to join in on Dr. Grier's plea for better sinus diagnosis and I want to thank Dr. Law for making me see the value of stereo-lateral examination of the ethmoids.

Better sinus diagnosis depends on two things—better pictures, i.e., better roentgenographic technique, and better seeing and interpretation by the roentgenologist. In regard to technique, I want to emphasize the importance of stereo examination, of complete immobilization, and of perfect centering of the patient. The anterior views should be taken in a true sagittal direction and the stereo shift should be made in a sagittal plane, so that both of the pictures of the stereo pair may be true sagittal projections. For me it is of value to have the patient sit up for the roentgenograms because in that way a sinus half full of fluid shows without equivocation, and one escapes the uncertainties of minor degrees of density.

I was glad Dr. Grier brought out the fact that maxillary sinuses which have been operated upon look very fuzzy and gray as a

rule. I think it is the duty of the roentgenologist to give a precise diagnosis and not be content with a report of "grayness in the right maxillary." I think he should report the maxillary as clear, lined with thickened mucous membrane, completely full of fluid, half full of fluid, or partly filled with a cyst or polyp, which, as Dr. Grier said, cannot be told apart by their roentgen appearance.

A fine division of diagnosis will be more helpful to a rhinologist than a mere report of suggested disease. I am able to see in many cases mucous membrane thickening in the ethmoid as well as in the frontals and in the maxillary and I have seen a few instances of definite mucous membrane thickening in the sphenoid sinuses.

DR. GRIER (closing). I am grateful for the kind remarks. I am sorry I did not start to read my paper from the back, because what I thought was the most important part of the paper is in the last two pages; and that is, the differentiation in the slight general opacities. These are the cases that get us in trouble with the rhinologist, because they may be due to a slight thickening of the membrane which has no significance at all, or to postoperative changes, or may mean hyperplastic sinusitis, or suppurative sinusitis which is draining well. There are four or five conditions with appearances all the same and one must have some idea of the history of the case in order to make a differentiation.





## PSEUDOFRACTURES (HUNGER OSTEOPATHY, LATE RICKETS, OSTEOMALACIA)\*

### REPORT OF A CASE

By L. A. MILKMAN, M.D.

SCRANTON, PENNSYLVANIA

**M**ISS G. M., aged forty, school teacher. *History of Present Illness.* In June, 1925, due to lameness in the back, pain on stooping over, difficulty on arising from either the lying or sitting posture, also pain across the small of the back, the patient sought medical aid. First, she went to a chiropractor. After receiving a series of "adjustments" she felt no better. Therefore she decided to see her family physician, who referred her to a gynecologist, orthopedist, neurologist, and nose and throat specialist. Several internists also studied her, with apparently negative reports.

In 1926, the patient went to Clifton Springs, N. Y., where she was studied by Drs. O'Dell and Wilson. No definite diagnosis was made, and strapping of the sacroiliac region was recommended. In July, 1927, she was observed and studied at the University of Pennsylvania by Dr. Spiller and his associates.

At present, the patient states that her condition is getting worse. She used to walk to school daily. Now she cannot walk because as soon as she steps on her right leg, she feels a severe pain in the upper end of the right femur. There is also a feeling as if her leg were going to give way. Any attempt to go up or down stairs produces severe pain in the right leg, and less marked pain in the left. There is also a feeling of uncertainty, as if she might stumble in walking. She cannot sit down because of severe pain in the right leg, and difficulty in rising. She sleeps well, and has no pain at night. Her appetite is good.

*Past Medical History.* Native American, normal birth, breast fed. Pneumonia at two years of age. Measles and mumps during childhood. No whooping cough, no typhoid fever, no influenza, no tuberculosis, no osteomyelitis. Acne vulgaris between the ages of eighteen and thirty, for which she received many inoculations. She thinks the inoculations may have had something to do with her condition. She went on an orange juice diet for six weeks after onset of illness, and took exercise to

reduce. She has had two attacks of appendicitis, but no operation. Three devitalized teeth were removed. Tonsillectomy in 1927. Two attacks of gravel in 1920 and 1922.

*Family History.* Father died at the age of sixty-five of arteriosclerosis. Mother is living and well at the age of seventy-four. No complaints at present. Patient is the seventh child of a family of eleven, nine of whom are living and well. One child died at the age of four of pneumonia. The other died ten days after birth—cause unknown. There is no family history of any peculiar bone lesions, bone operations, or malignancy.

*Physical Examination.* Adult female about 5 feet 3 inches tall, fairly well nourished, stands erect, no abnormal curvatures or bowing, does not appear to be suffering or in pain. She walks with a waddle gait, and if after sitting down is asked to rise, she hesitates for a while before rising, and then evidence of pain is noted in her expression. Questioned as to why she hesitates, she states that she has no strength in her muscles, also that time is necessary for her to get up the required energy to rise, and that the pain is also a factor. Her weight at present is 129 pounds, a loss of 10 pounds in four or five years.

*Head.* No deformities, does not appear pushed down at its junction with the neck. Nose and throat negative.

*Eyes.* Pupils round, equal and react to light and accommodation. Dark brown in color. *No blue sclerotics.*

*Neck.* Thyroid gland palpable, but otherwise no abnormal findings.

*Chest.* Pain on pressure over sternum and ribs. No crepitus felt.

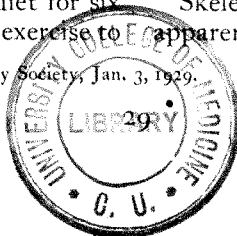
*Lungs and Heart.* Grossly negative.

*Abdomen.* No palpable masses, no rigidity, no abnormal protrusions.

*Gynecological Examination.* Negative for new growth or other pathology.

*Skeletal Examination.* Bones of skeleton are apparently of normal growth, no bending or

\* Read before the Philadelphia Roentgen Ray Society, Jan. 3, 1929.



bowing, or other deformities, no enlargement, no crepitus, no abnormal mobility. Tenderness over both femurs just below the trochanters, ribs and sternum as previously mentioned, also over right ulna. The patient is able to point out the tender spots. Knee jerks, ++.

Neurologic examination by Dr. Spiller, report as follows:

I have found the study of Miss M's condition exceedingly interesting. There is much to suggest the presence of dystrophia myotonica in her case. Her age is in conformity with this diagnosis, and her lack of initiative in commencing voluntary movement with the lower limbs is very suggestive of this diagnosis. It is far from being a typical case. The disturbance of movement is confined to the lower limbs, and is one of failure at prompt onset of movement without any perseveration. Usually there is definite implication of the hands. The patient has perseveration, and when he grasps an object he is unable to let go of it immediately. Miss M. has none of this. Often there is myotonic electrical reaction. She shows none of this. Reactions of the muscles of the back and lower limbs are normal, there is no suggestion of the slightest degree of myotonic reaction. Often there is muscular atrophy. No atrophy is present in her case. Frequently, striking the thenar eminence or the tongue will cause a muscular lump to form, which gradually disappears. Miss M. does not show this. The case is very atypical, and yet it is certainly possible that her inability to rise promptly from a chair and to walk off at once, the pain in the muscles of the thighs when she attempts too sudden movement of the lower limbs or when someone suddenly moves the lower limbs, may be dystrophia myotonica. No one in her family has had the characteristic cataract. The omissions of the symptom-complex of this case, the prompt tendon reflexes of the lower limbs, have caused me to study the condition with the possibility of astasia abasia in mind. This is a hysterical condition. Miss M. does not have astasia.

The lumbar spine, sacroiliac region and hips are negative in the roentgen examination. Dr. Orr, an orthopedic surgeon, finds no abnormality of the hip joints. Dr. Keene, by vaginal examination finds nothing abnormal. The disease will progress slowly. There is no cure for myotonia.

#### *Laboratory Examinations.*

Roentgen examinations in 1925, by Dr. Jackson, of the sinuses, genitourinary tract, teeth, lower dorsal and lumbar spine were negative, except for the three devitalized teeth. Cystoscopic and pyelographic examinations at Clifton Springs, N. Y., were negative.

Blood and spinal fluid Wassermann tests

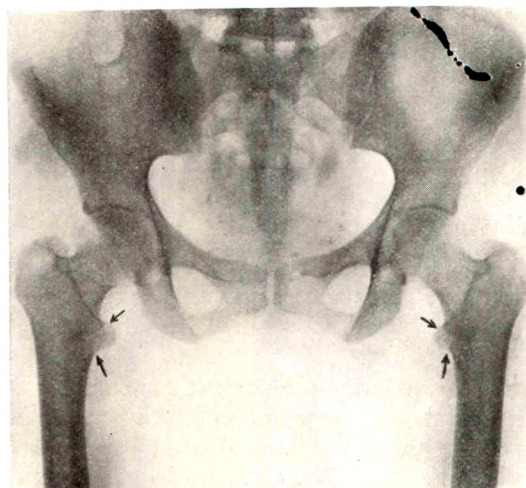


FIG. 1. Roentgenogram taken in July, 1927. Note the pseudo-fracture at the lesser trochanter extending towards the shaft, bilateral and symmetrical. This condition was overlooked in first examination at another hospital.

made on various occasions and in different laboratories were negative.

Blood chemistry—urea, uric acid, creatinine, and sugar were normal. Sugar tolerance test negative.

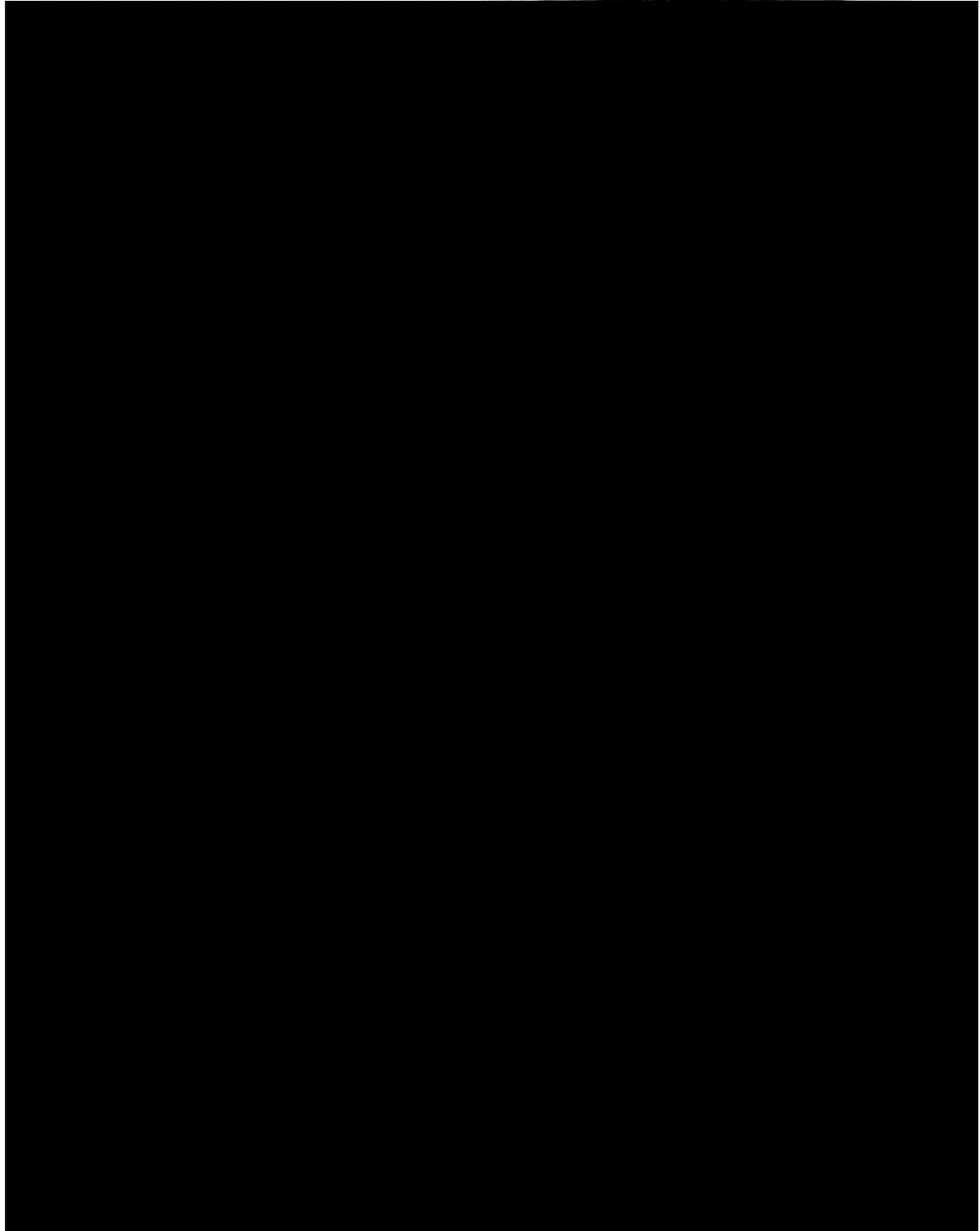
Blood count—no abnormal findings.

Urine examination—sp. gr. 1014, negative for sugar, albumin or casts. No Bence-Jones proteins.

Blood pressure—138/90; later 120/90; pulse 84; temperature 98.2° F.

Patient was referred to Scranton State Hospital, to a special clinic held by Prof. Bauer of Vienna, in March, 1928. After his examination, Prof. Bauer suggested a diagnosis of osteomalacia, based on the peculiar gait (waddling), and pain on pressure over the chest. He referred the patient to the roentgen department for study before presenting her to the clinic. Roentgen examination was made of the chest, thoracic and lumbar spine, pelvis and hip joints. The films revealed no evidence of osteomalacia as generally accepted. Just below the great trochanters of the femurs there appeared bands of increased radiopacity that involved the cortex, measuring about 2 mm. in diameter. This transparency apparently divided the bone into two separate parts. In the opposite femur a similar zone of transparency was seen in the identical location, yet there was no displacement (Figs. 1 and 2).

Similar transparency zones with loss of cortical substance were seen in the scapulae, radii, ulnae, metatarsal bones, fibulae, and in the 6th, 7th, 8th, 9th, 10th and 11th ribs (Figs. 3 to 8). The 10th rib has a fracture 1 inch from





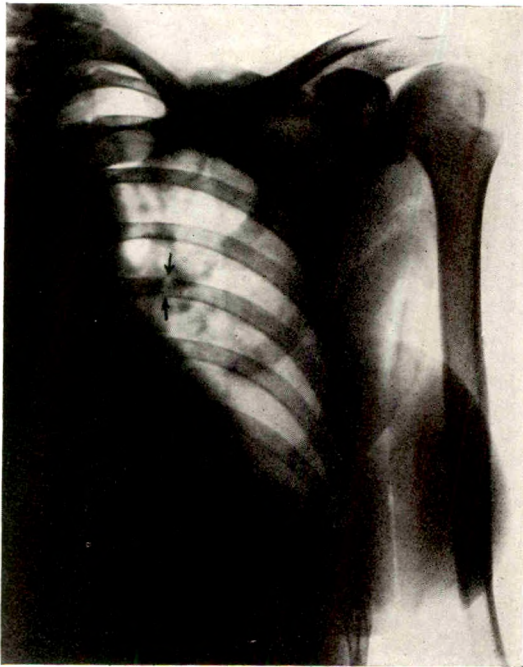


FIG. 4. Transparency zone (pseudofracture) seen in 6th rib, left side. On later films the separation is more marked.

transparency zones is frequently observed, and in healed cases the transparency zones disappear entirely and appear more dense. The striking feature of this bone lesion is that there is no evidence or history of trauma of sufficient force to produce such a multiple type of lesion and that the appearance of the patient contradicts the roentgen findings, also function is only partially interfered with, compared with the multiplicity of changes in the skeleton. Whenever a new site of bone is involved the patient can foretell its location by the tenderness over this area. In fact, pain appears before there are any roentgen signs of bone changes. At present she is having severe pain in both ulnae, and at the next roentgen examination lesions will probably appear there. The roentgen examinations made at intervals show the progress of the lesion.

Following the war there appeared in the German and Austrian literature a variety of conditions affecting the osseous system,

which were grouped under the term of "hunger osteopathy". Some could be classified as rickets, others as late rickets, others as juvenile osteomalacia, still others as osteomalacia and senile osteoporosis. The rachitic and late rachitic changes were seen in younger and the osteomalacic changes in older persons. The Viennese cases resembled osteomalacia, with a preponderance in the female sex beyond the menopause. The condition in the patients of Porges and Wagner who were thirty to fifty years old, and in a poor general state, resembled osteomalacia. The cases of Wassermann, Kraus and Citron also had edema. In the cases of Fromme and of Simon, there was a marked preponderance in youth in the male sex. All appear in the final analysis to be the result of the same basic cause, this trauma to the skeletal

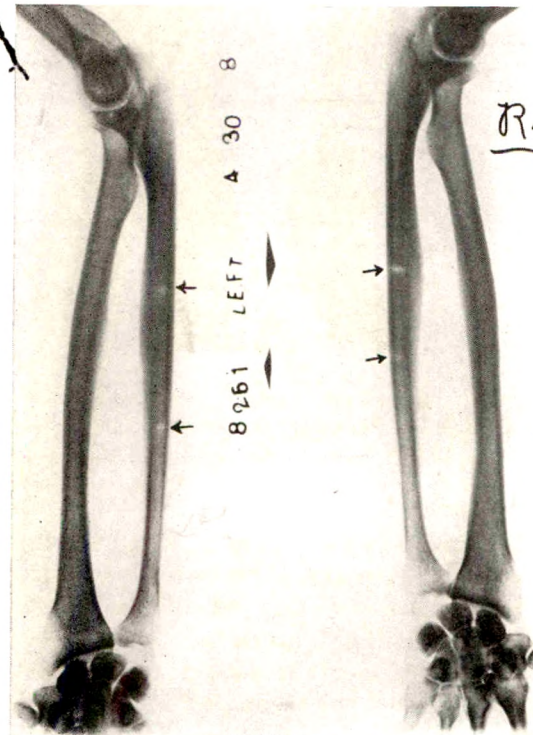


FIG. 5. Transparency zone beginning as punctate area in upper third of right ulna, and a similar process about an inch below involving the cortex. Two areas can also be noted in the left ulna, but not in perfect symmetry with right.



system leading to the rachitic type in males and to the osteomalacic type in females. Looser considers rickets, late rickets, and osteomalacia one and the same condition, differing only in secondary factors due to age, and he classifies all the hunger osteopathies under rickets, late rickets and osteomalacia. Simon could not find proof of the statements of Hocksinger that rachi-

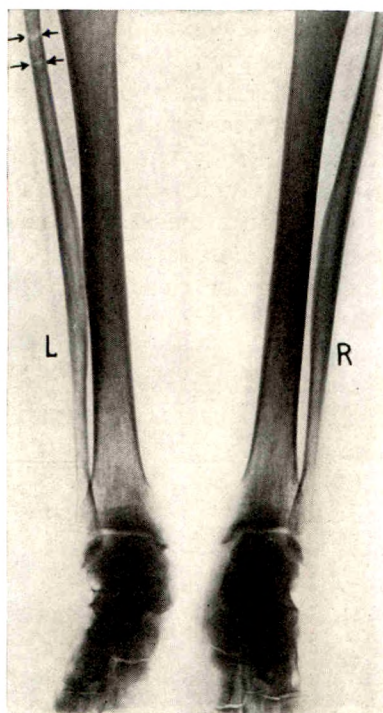


FIG. 6. Transparency zones involving upper end of fibula. The right is as yet not involved. Note the lack of lime salts in the region of the pseudofracture, with no evidence of repair or periosteal reaction.

tis tarda always developed on an early rachitis. I could find no history or signs in the skeleton of early rickets in the case presented. The impression obtained from the literature is that the cases in the males resemble rachitis tarda and in the females osteomalacia, except in psychotic old men. Porges, and others, have stated that the  $\text{CO}_2$  combining power of the blood is different in true osteomalacia from the osteomalacia associated with pseudofractures. The symptom-complex that most

authors are agreed upon is: (1) lumbosacral pain; (2) general weakness; (3) waddle gait; (4) difficulty in raising legs as in climbing stairs; (5) tenderness over the various portions of the skeleton, especially over chest and pelvis; (6) increased patellar reflexes, and (7) skeletal changes resembling osteomalacia or late rickets. Besides the above there are various other phenomena such as edema without definite kidney lesions. In many of the cases the above symptoms, especially in children and young adults, were misinterpreted as rheumatism and in children as growing pains, and were treated for rheumatic affection. The term "growing pains" should always be a danger signal, and there should be a complete physical and roentgen examination, because the health of so many children and young adults has been endangered by this euphonism.

#### ETIOLOGY

Most of the European writers on the subject stated that the etiologic factor was lack of food. They also incriminated some or all of the endocrines and finally vitamins. The influenza epidemic of 1918 was considered as a contributory factor by several authors. This patient has not had any insufficiency of food. Careful examination revealed no abnormalities of the endocrine glands, also no deficiency of vitamins in her diet could be discovered, and when she was put on a diet rich in various vitamins there was no improvement. The fact of increased reflex excitability is interesting and important in that it may be regarded as an expression of a lesion of the endocrine system, especially the parathyroids. Schüller, in 1909, during a tetany epidemic in Vienna noted coexisting bone changes which he regarded as rachitis tarda, yet the more recent work of Mendel and Albright showed the lesions produced by a disturbance of the parathyroid gland to be of the cystic type. The case under discussion shows no evidence of bone cyst formation. Added to the above





FIG. 7. Punctate area involving lower third of left ulna. This is characteristic of the beginning of the lesion, which then extends through the entire shaft as though the calcium has been absorbed or cut through.

are various neurologic symptoms and many of them are contradictory, so that one definite entity cannot be diagnosed. Hysteria was frequently associated, especially in young girls, and spasm in the various muscle groups. Schlesinger explains this as a defense mechanism. The disturbance in gait is explained by Schlesinger and Shiff as due to muscle weakness or to paresis of the iliopsoas muscle. Simon thinks it is due to the transformations in the bone, although muscle weakness may help.

A. This condition differs from an osteopsathyrosis or fragilitas ossium in these details: (1) it is not familial; (2) no blue sclerotics; (3) no difficulty in hearing; (4) no evidence of repair; (5) the symmetry of the lesion as to location and degree; (6) lack of deformity; (7) no history of trauma. This condition differs from the type of fragilitas ossium known as osteopetrosis or marble bones, Marmorknochen, Marmorskelett,

Albers-Schönberg's disease, diffuse osteosclerosis, etc., in that it shows no evidence of sclerosis of the osseous system, no epiphyseal deformities, physical underdevelopment, hydrocephalus, anemia and other secondary characteristics usually associated with osteopetrosis.

In a review of the literature Hass refers to Lobstein's description of idiopathic osteopsathyrosis in 1825. Later Gurlt, Griffith, Broca, Herbult, Looser, Axhausen, Lipschutz, Matswoka, Eckman, Vonrebling, etc., all describe and recognize familial and hereditary factors in osteopsathyrosis, and they mention the various familial stigmata mentioned above. Many of their patients were either in their early childhood or adolescence. They do not describe one patient past thirteen years of age.

The patient described in this article does not possess any of the history or stigmata associated with idiopathic osteopsathyrosis.

B. The case differs from multiple myeloma: (1) head shows no evidence of lesions usually seen in multiple myeloma; (2) the character of the lesion is not of the punched-out type as is usual with multiple myeloma; (3) the distribution of the lesion is not typical of multiple myeloma; (4) urine shows no evidence of Bence-Jones proteins. The above differential factors also apply to chloroma, with the added fact that the patient has no leucemia.

C. It differs from malignancy: (1) no primary focus; (2) history and duration. Patient shows no evidence of cachexia; (3) no evidence of invasion of surrounding structures; (4) from a roentgen viewpoint the lesions do not show the characteristics of a lesion due to malignancy.

D. It differs from lues: (1) repeated negative Wassermann reactions; (2) negative history; (3) negative family history; (4) no clinical evidence; (5) roentgenologically syphilis is a sclerosing as well as destructive lesion. This lesion shows no evidence of sclerosis; (6) does not respond to specific treatment.

E. It is not osteogenesis imperfecta: (1) this condition appears soon after birth; (2) bone deformities are usually present in osteogenesis imperfecta, but are not present in the case described; (3) roentgen examination of this patient three and one-half years ago showed no evidence of bone changes or any bone deformities.

F. Peculiar bone changes are found in the insane: (1) this patient shows no signs of insanity; (2) she still is following her profession as school teacher; (3) she has no psychiatric symptoms.

G. Dystrophia myotonica—the diagnosis suggested by Dr. Spiller. All the literature on the subject was abstracted and reviewed for Dr. Spiller, and no mention of any bone changes are reported. This might be due to two reasons: (1) Dystrophia myotonica is a rare condition; (2) the patients may never have been roentgenographed, but it seems hardly plausible that if the patients had complained of any symptoms referable to the osseous system, roentgenograms would not have been

(7) calcium lactate and a diet rich in calcium salts, especially leafy vegetables; (8) physiotherapy, including high frequency; (9) viosterol. The patient states that aspirin gr. x, t.i.d., gives her most relief and enables her to walk better.

The fact that in the German and Austrian literature the various patients responded to some or all of the above-mentioned treatments, and that some responded to a correction of diet, again suggests that many different types of bone lesions and systemic disorders were grouped under the name of hunger osteopathy, and the fact that some of the patients reported did not suffer from food privation—some came from the country districts where food was plentiful—makes me believe that we have not as yet found out the etiologic factor in this condition.





If one accepts Looser's views, then rickets, late rickets and osteomalacia are the progressive representation of the same pathology, and the different symptoms are due mainly to the age period that the skeleton is exposed to insult. Of course I have not been able to make any pathologic sections of the case reported, and therefore I am handicapped in not knowing the actual pathology present. From the character of the lesion, it can be stated that it is of systemic origin involving the centers of bone metabolism, perhaps the blood supply in the particular portion of the bone, especially as this case has shown no tendency to repair. I therefore believe

the condition described here forms a definite clinical entity which will become more distinct as bone pathology is better understood, and a definite etiology may be determined.

The reason for reporting this case is that the roentgenograms were shown to many of the prominent roentgenologists throughout the United States, and they apparently were not familiar with the cases reported by the German and Vienna workers, and also there apparently has been no similar cases reported in the American literature.

\* I want to express my sincere thanks to Drs. Pfahler, Pancoast and Pendergrass for their kind assistance, and to Drs. Butzner and McDonnell for permission to use their clinical records.

#### REFERENCES

1. ABELS, H., and KARPLUS, DORA. Significance of congenital weakness of ossification for the development or rickets. *Wien. klin. Wchnschr.*, 1927, 40, 1069-1072.
2. ALWENS. Osteomalazie, osteomalazieähnliche Erkrankungen; Rachitis tarda. *München. med. Wchnschr.*, 1919, 66, 1242.
3. ALWENS. Ueber die Beziehungen der Unterernährung zur Osteoporose und Osteomalazie. *München. med. Wchnschr.*, 1919, 66, 1071-1075.
4. BAETJER and WATERS. Injuries and Diseases of Bones and Joints. Paul B. Hoeber, New York, 1921.
5. BLOODGOOD, J. C. Diagnosis and treatment of benign and malignant tumors of bone. *J. Radiol.*, 1920, 1, 147.
5. BROCKMAN, E. P. Some observations of the bone changes in renal rickets. *Brit. J. Surg.*, 1927, 14, 634-635.
6. BURNHAM, A. C. Spontaneous fracture and bone cysts. *Interstate M. J.*, 1913, 20, 1021-1024.
7. CARMAN, R. D. A review of the roentgenology of syphilis. *Collected Papers of Mayo Clinic*, 1918, 10, 616-645.
8. CODMAN, E. A. Pathological fractures. *Surg., Gynec. & Obst.*, 1922, 34, 611-613.
9. DÉREUX, JULES. Contribution a l'étude de l'ostéomalacie infantile. *Presse méd.*, 1926, 34, 834-838.
10. DWYER, HUGH L., and ECKELBERRY, O. S. Osteomalacia in children. *Am. J. Dis. Child.*, 1926, 31, 639-653.
11. EISLER, F. Ueber Hungererkrankungen des Skelettsystems. *München. med. Wchnschr.*, 1919, 66, 1057.
12. EWING, J. Neoplastic Diseases. W. B. Saunders & Co., Philadelphia, 1922.
13. FRASER, JOHN R. The ovary in osteomalacia. *Am. J. Obst. & Gynec.*, 1927, 14, 697-712.
14. FRIEDMAN, EMANUEL, and COLE, F. N. Idiopathic osteopsathyrosis (fragilitas ossium). *Arch. Pediat.*, 1927, 44, 766-774.
15. FROMME, A. Ueber eine endemisch auftretende Erkrankung des Knochensystems. *Deutsche med. Wchnschr.*, 1919, 45, 510-514.
16. GROEDEL, FRANZ M. Roentgendiagnostik in der inneren Medizin. J. F. Lehmann, München, 1924.
17. HASS, S. L. Practice of Surgery—Dean Lewis. Vol. 2, 1-132. W. F. Prior & Co., 1928.
18. HASS, JULES. Zur Kenntnis der Osteopsathyrosis. *Med. Klin.*, 1919, 15, 1112-1115.
19. HOLMES and RUGGLES. Roentgen Interpretation. Lea & Febiger, Philadelphia, 1926.
20. HONIGMANN, F. Ueber Pseudofrakturen (Umbauzonen). *München. med. Wchnschr.*, 1925, 72, 1789-1792.
21. KARSHNER, R. G. Roentgen studies of the bones in certain diseases of the blood and hematopoietic system. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1928, 20, 433-439.
22. KARSHNER, R. G. Osteopetrosis. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1926, 16, 406-419.
23. LOOSER. Pathological forms of infractures and callus formations in rachitis, osteomalacia and other diseases of the bones. *Centralbl. f. Chir.*, 1920, 47, 1470-1474.
24. LOOSER, E. Ueber Spätrachitis und Osteomalacie. *Deutsche Ztschr. f. Chir.*, 1920, 152, 210-357.
25. MEYERDING, H. W. Cystic and fibrocystic disease of the long bones. *Collected Papers of Mayo Clinic*, 1918, 10, 871-907.



26. MEYERDING, H. W. Multiple myeloma. *Collected Papers of Mayo Clinic*, 1924, 16, 880-887.
27. MOORE, A. B. Osteoporosis in exophthalmic goiter. *Radiology*, 1928, 11, 254.
28. NOBLE, THOMAS P., and HAUSER, E. D. W. Acute bone atrophy. *Collected Papers of Mayo Clinic*, 1924, 16, 847-866.
29. O'LEARY, PAUL A. Stigmas of late congenital syphilis. *Collected Papers of Mayo Clinic*, 1924, 16, 656-666.
30. PORGES, O., and WAGNER, R. Ueber eine eigenartige Hungerkrankheit (Hungerosteopathie). *Wien. klin. Wchnschr.*, 1919, 32, 385-387.
31. RASCHER, R. Spontaneous fractures in osteomyelitis and the influence on it of war feeding. *Diss.*, 1920, p. 23.
32. SCHMIDT, M. B. Referat über Rachitis und Osteomalacie. *Verhandl. d. deutsch. path. Gesellsch.*, 1909, 3-20.
33. SIMON, W. V. Ueber Hungererkrankungen des Skelettsystems. *München. med. Wchnschr.*, 1919, 66, 799-804.
34. STONE, E. L. A brief review of the literature of osteomalacia with a report of a case necessitating delivery by caesarean section. *Surg., Gynec. & Obst.*, 1924, 39, 599-609.
35. THOMPSON, L. Syphilis, Diagnosis and Treatment. Lea & Febiger, Philadelphia, 1920.
36. URECHIA, C. I., and BODEA, I. Osteomalacia in a girl aged seventeen. *Bull. et mém. Soc. méd. d'hôp. de Par.*, 1927, 49, 511-513.
37. VON PFLAUNDLER. Die Entstehung der rachitischen Veränderungen. *Klin. Wchnschr.*, 1927, 6, 284.



# ANOMALOUS ENLARGEMENT OF THE LIVER AND A DISSECTING HEMATOMA OF THE PHRENIC NERVE\*

## CASE REPORT

By KARL KORNBUM, M.D., and GEORGE W. STEPHENSON, M.D.

PHILADELPHIA, PENNSYLVANIA

THE case here reported was of interest because of two rather unusual conditions found at autopsy, which made clear certain roentgen observations for which no adequate explanation was found during the life of the patient.

The patient was sixteen months of age. She was one of six children, her birth and postnatal development being normal. She had never been sick until the illness which proved fatal.

About three months before admission to the University Hospital, service of Dr. J. Claxton Gittings, she had contracted whooping cough, which was evidently severe but not unusually so. One month before admission she began to run an irregular fever, which her family physician pronounced as the onset of pneumonia. This, he told the family, cleared up one week before admission.

At about the time she was said to be recovered from the pneumonia, she had a severe general convulsion and became stiff and blue. A similar attack occurred the following day. Pharyngitis and diarrhea were noticed at this time, and she was put on a restricted diet. She apparently improved somewhat until the day before admission, when pus began to drain from her right ear and she complained of some pain in the region of her left elbow which was swollen.

On admission she was described as fairly well nourished, markedly toxic and coughing occasionally in paroxysms. In addition to the discharging ear and swollen arm, she was found to have signs of consolidation with diminished breath sounds at the base of the right lung and a liver palpable about 3 cm. below the costal margin. The admission diagnosis was acute otitis media, acute stomatitis, bronchopneumonia with empyema, and diarrhea following parenteral infection.

Laboratory studies showed a definite anemia with reduced hemoglobin and a leucocytosis of

12,700 of which 75 per cent were polymorphonuclear cells. Blood culture showed a heavy growth of hemolytic *Streptococcus pyogenes* at twelve hours.

A roentgenogram of the left elbow did not reveal any disease process in the bones. Roentgen examinations of the chest were of particular interest. The first examination on admission showed at the roentgenoscopic observation

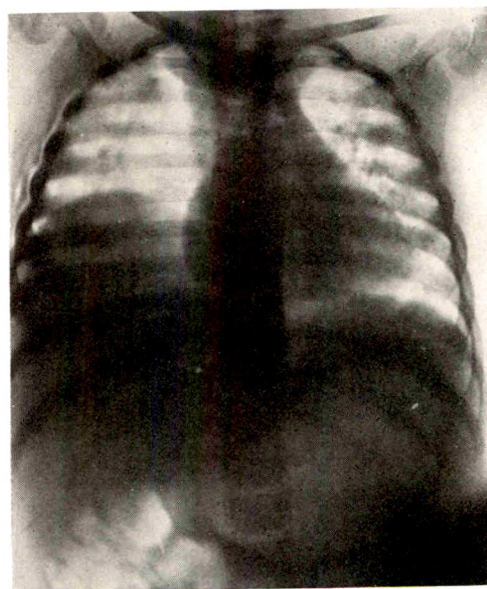


FIG. 1. Anteroposterior view of the chest on admission.

some restriction in the motion of both diaphragms. The roentgenograms in the anteroposterior view (Fig. 1) revealed a diffuse mottling of both lungs with a dense shadow at the right base, which in the lateral view (Fig. 2) gave the characteristic appearance of an interlobar collection between the right middle and lower lobes. The interpretation was a bilateral bronchopneumonia with an interlobar collection between the right middle and lower lobes.

\* From the Departments of Roentgenology and Pathology, University of Pennsylvania, Philadelphia, Pa. Read before the Philadelphia Roentgen Ray Society, Nov. 7, 1929.



The possibility of a liver abscess was also considered. A thoracentesis was attempted but only a few cubic centimeters of bloody fluid could be secured. A second roentgen examination was made five days later. At the roentgenoscopic examination there was noted a typical paradoxical movement of the right diaphragm indicating a paralysis of the right phrenic nerve. The appearance on the roentgenograms was much the same as at the first examination. There was some increase in the pneumonic process in both lungs while the shadow at the right base in the lateral view was even more characteristic of an interlobar collection.

The treatment consisted largely of fluids and transfusions. In the six days that the patient was in the hospital she received 635 c.c. of citrated blood in five transfusions and several subcutaneous injections of normal salt solution. After the last transfusion, she had a normal red cell count and almost normal hemoglobin.

The course in the hospital was progressively downhill, with a temperature which was persistently elevated, ranging from 104–106° F., and a cough which was annoying and unabated.

The day following the last roentgen examination of the chest the patient's condition became markedly worse and she died.

At autopsy, the few positive findings were as follows:

(1) Small puncture wounds, evidently made by transfusion needles, in the antecubital spaces, and in the neck along both sternomastoid muscles.

(2) Bronchopneumonia in the right lower lobe, with no evidence of previous or present pleural exudate. There were no pleural adhesions.

(3) A high right dome of the diaphragm, rising to about the level of the second interspace anteriorly. The muscle was of the same thickness as the left dome, and was apparently normal.

(4) Upon exposure, the liver was found to be much enlarged, particularly on the right side, so that some pathology was suspected. There was no subdiaphragmatic exudate or adhesions, and the rest of the surface of the organ was perfectly smooth and normal. Upon cutting the organ, it was found to consist of apparently normal liver tissue throughout, and this later proved to be so by microscopic examination.

The right lobe was about 15 cm. thick.

(5) The spleen and kidneys showed the customary changes found in an overwhelming blood stream infection.

(6) Under the pleura, on the right side of the mediastinum, a liquefying hematoma was seen, extending down the course of the large veins, involving the right phrenic nerve, both by surrounding it and by distending the tissues in which it lay. This hemorrhage had forced its way into the thymus, and could be traced up to the sites of the transfusion. On lifting the skin on the other side of the neck, a small subcutaneous hematoma was found lying over the inner end of the left clavicle.

The pathological diagnoses were: cause of death: septicemia; underlying causes: bronchopneumonia; acute embolic nephritis; otitis media.

Coincidental findings: dissecting hematoma about the right phrenic nerve; anomalous enlargement of the right lobe of the liver.

It is the last two of these findings to which we wish to call special attention. Taking them in order, it will be recalled that at the last roentgenoscopic examination paradoxical movement of the dia-

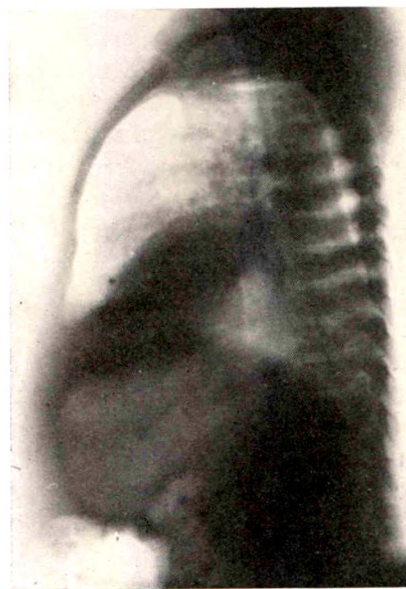


FIG. 2. Right lateral view showing a shadow at the base simulating an interlobar collection of fluid between the right middle and lower lobes.



phragm was observed on the right side. This was undoubtedly due to paralysis of the right phrenic nerve occasioned by the dissecting hematoma. One has but to re-

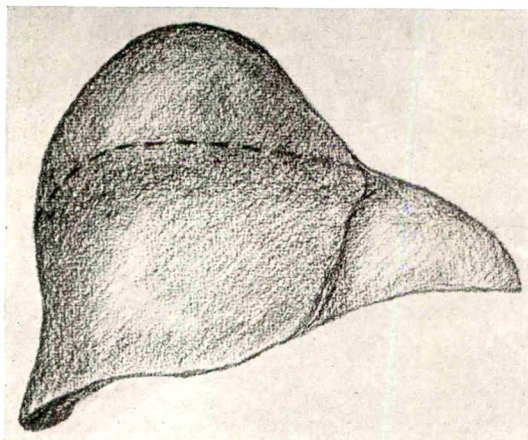


FIG. 3. Drawing made of the liver removed at autopsy. The broken line indicates the approximate position of the superior surface of a normal liver.

call the intimate relation between the internal jugular vein and the phrenic nerve in the neck to understand the manner in which extravasated blood from the internal jugular vein might readily find its way along the phrenic nerve and thus by pressure cause considerable damage, at least functionally. That this extravasation of blood may occur even under the best of care, and with good technique, should be understood. That this occurrence is not more frequently encountered is probably due to the fact that paralysis of one phrenic nerve is not usually accompanied by physical signs or symptoms. Thus its detection would depend largely upon roentgenoscopic examination as in the case here presented.

Of equal practical importance is the knowledge that anomalies of form of the liver occur, there being no pathological change in the tissue or its function. Most of these anomalies of the liver are probably carried about undiagnosed, in fact unsuspected, only coming into prominence when

they confuse diagnosis in some entirely unrelated disease. The drawing (Fig. 3) gives a comparison of this liver with the normal.

They are for the most part congenital, and therefore may be seen at any age. Formerly, much stress was laid on the deformation of livers by tight lacing and wasp-waist corsets, the pathologists of fifty years ago mentioning these forms specifically. It seems to be generally accepted now that these unusual markings have little or no connection with the styles, but represent congenital irregularities of development.

The roentgen diagnosis of a collection of pus in the interlobar fissure made primarily on the lateral films, resulted from a shadow caused by the overlapping of the heart, and the high right lobe of the liver. Back of the heart an area of lesser density may be seen on close examination, representing the liver, with overlying lung. This shadow was so far above the upper limit of the normal liver that this organ was not considered when the film was viewed.

As to the relative frequency of anomalies of lobulation in the adult liver, there are unfortunately few figures or authoritative statements available, either in textbooks or in the recent literature. In discussing the formation of the liver, Piersol says in part, "One peculiar form of liver occasionally met with shows great increase of the right lobe, particularly in a vertical direction, with want of development of the left lobe, which is thin and short." This, certainly, is an anatomist's description of the condition found in our subject, but gives little hint of how frequently we may expect it to be found.

One of the popular texts on pediatrics, that of Holt and Howland, takes no note of abnormal form of the liver, except where there has been anomalous development of the fetus as a whole.

The exhaustive work in pathology by Kauffmann, recently translated into English

by Reiman, makes the statement that "abnormal lobulation is not rare."

H. E. MacMahon in a recent article upon anomalies of the liver is most concerned with unusual development of portal and biliary systems. He considers abnormalities of the liver uncommon, and anomalies of size as relatively rare.

So we are forced to conclude that no definite figures are available, but that enlargement of the right lobe such as was seen in our subject is not unknown, at least

to a lesser degree. How frequently one may expect to encounter this condition in everyday experience is problematical.

Thus it is seen that this case presented two unusually interesting features. The anomalous enlargement of the liver is probably of such rare occurrence as to be of little clinical importance. The possibility, however, of a paralysis of the diaphragm as a complication in the use of the jugular veins for the purpose of transfusion affords knowledge of distinct clinical value.



## THE REACTION OF LYMPHOID TISSUE TO ROENTGEN RADIATION

By HACHIRO AKAIWA, M.D., and MITSUZO TAKESHIMA, M.D.

*From the Surgical Clinic of the Medical College*

OKAYAMA, JAPAN

ROENTGEN radiation has become more and more serviceable in its medical application and the experimental study of its effects upon tissue has also become more systematic. The use of radiation in the diagnosis and cure of various

Since in the literature very little mention is made of the relation between the amount of radiation and the reaction in the lymph nodes, we have undertaken the study of this relation. For experimental animals we used rabbits, weighing about 2 kilos



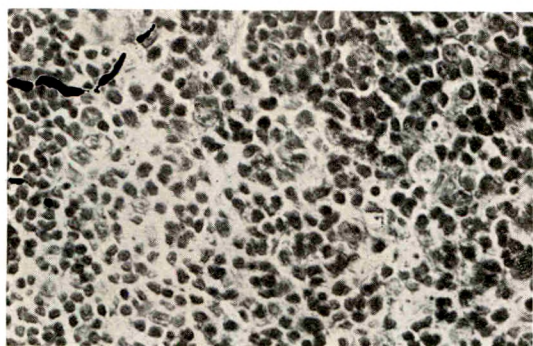


FIG. 1. Lymph node seven days after exposure to a small roentgen dose ( $1/3$  S.U.D.). There is some increase in connective tissue. An occasional phagocyte is seen.



FIG. 2. Lymph node two weeks after exposure to one medium roentgen dose ( $1/2$  S.U.D.). Marked fibrosis of the gland.

follicles run very fine lymph sinuses which accompany the trabeculae of the node as they approach the hilus. Here the sinuses are much larger, are lined with their usual endothelial cells and are separated from one another by masses of lymphocytes here known as medullary cords. In addition to the lymphocytes there are also seen occasional eosinophilic mononuclear cells. Emerging from the hilus along with the lymphatics are several small blood vessels.

Thirty minutes after exposure to the smallest amount ( $1/3$  S.U.D.) of radiation, we note that the cells in the lymph follicles and especially in the germinal centers are enlarged. After one hour the nuclei of many of these cells begin to show disintegration which reaches its height in from two to six hours. From this time on marked phagocytosis is noted, the phagocytes taking up the chromatin particles of the decomposed nuclei. At the same time mitotic figures are noted among these cells. Six hours after irradiation there appears some clearing up of the decomposed tissue, due to the above mentioned phagocytosis, and this function almost ceases after forty-eight hours, although slight evidence of it may remain for five days. Due to this disintegration of lymphocytes there is a marked decrease in the number of these cells in the lymph follicles at forty-eight hours. From now on there is a period of

regeneration so that after the seventh day the lymph gland is back to normal except for a slight increase in the connective tissue (Fig. 1). If the gland on the opposite side, which was not irradiated, is now examined, one finds at the one hour period a slight increase in the number of mitotic figures. At the second hour there is some disintegration of the cells in the lymph follicles. Phagocytosis is definitely present at twenty-four hours and the condition of decomposition in the lymph node can be recognized up to the tenth day and returns to normal only after two weeks.

In the next series of experiments, using a moderate degree,  $1/2$  S.U.D., of radiation, phagocytes are seen in the lymph follicles at thirty minutes; at one hour there is disintegration of nuclei of cells in the follicles; at two hours this decomposition is marked and reaches its height at the sixth hour. By the twelfth hour the phagocytes have cleared up most of the nuclear fragments, accompanying which there is great decrease in the number of lymphocytes. At forty-eight hours the phagocytes are no longer present and mitoses are regularly seen. From then on there is regeneration and at the end of the third week all that remains as evidence of this irradiation is an increase in the connective tissue in the lymph node (Fig. 2). Macroscopically there is an increase in the lymph gland after two hours which



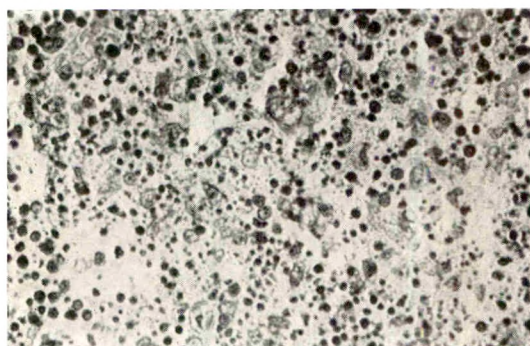


FIG. 3. Lymph node six hours after exposure to a larger roentgen dose (1 S.U.D.), showing decomposition of the gland.

then decreases so that from the first to the second week it is smaller than normal and by the third week it has resumed its normal size. On the control side, the changes seen after a moderate dose are the same as those seen after a small dose of radiation, namely, an increase in the mitotic figures and phagocytes after one hour, with decomposition up to the sixth

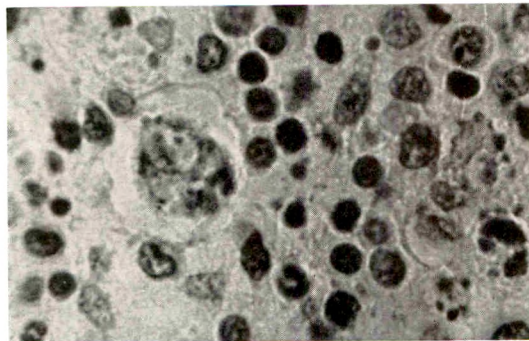


FIG. 4. The same as Figure 3, but higher power. Many phagocytes are seen.

hour. At the twelfth hour there is a marked increase in the mitoses. From the third day on there is an increase in connective tissue; at the tenth day hardly any mitotic figures are seen, but disintegration of the nuclei reappears with phagocytosis. At the end of the third week there is much more fibrosis. The end-result then parallels the difference in degree of radiation.

In the third series, a large amount of radiation, 1 S.U.D., was used. At thirty minutes there is marked degeneration of

the lymph follicles accompanied by increased activity of the endothelial cells. This decomposition reaches its height at the sixth hour when one sees in addition eosinophilic cells and what appears to be an exudate (Figs. 3, 4 and 5). From now on until the twenty-fourth hour there is very active phagocytosis of the nuclear fragments. From the forty-eighth hour this activity slows down and ceases on the

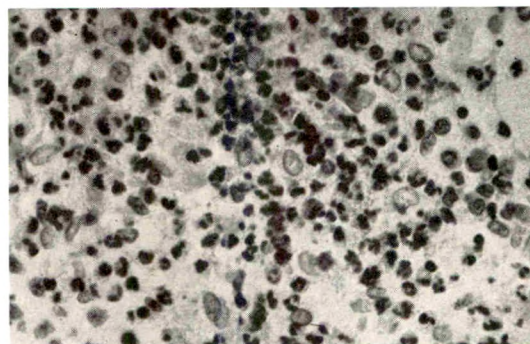


FIG. 5. The same as Figure 3.

fifth to seventh days. From now on there is proliferation of connective tissue up to the third week (Figs. 6 and 7). On the control side with the large amount of radiation you see an increase in mitoses at one hour and at the second hour a large number of phagocytes. Decomposition appears later, from the sixth to the forty-eighth hour, accompanied by marked phagocytosis, all of which disappears by the seventh day.

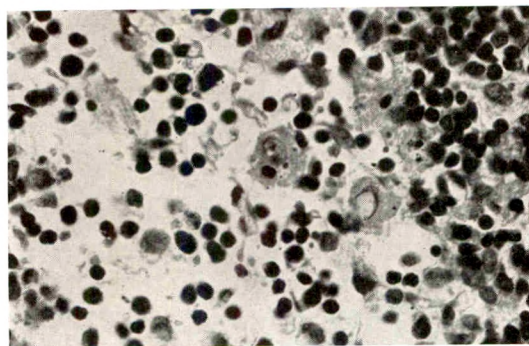
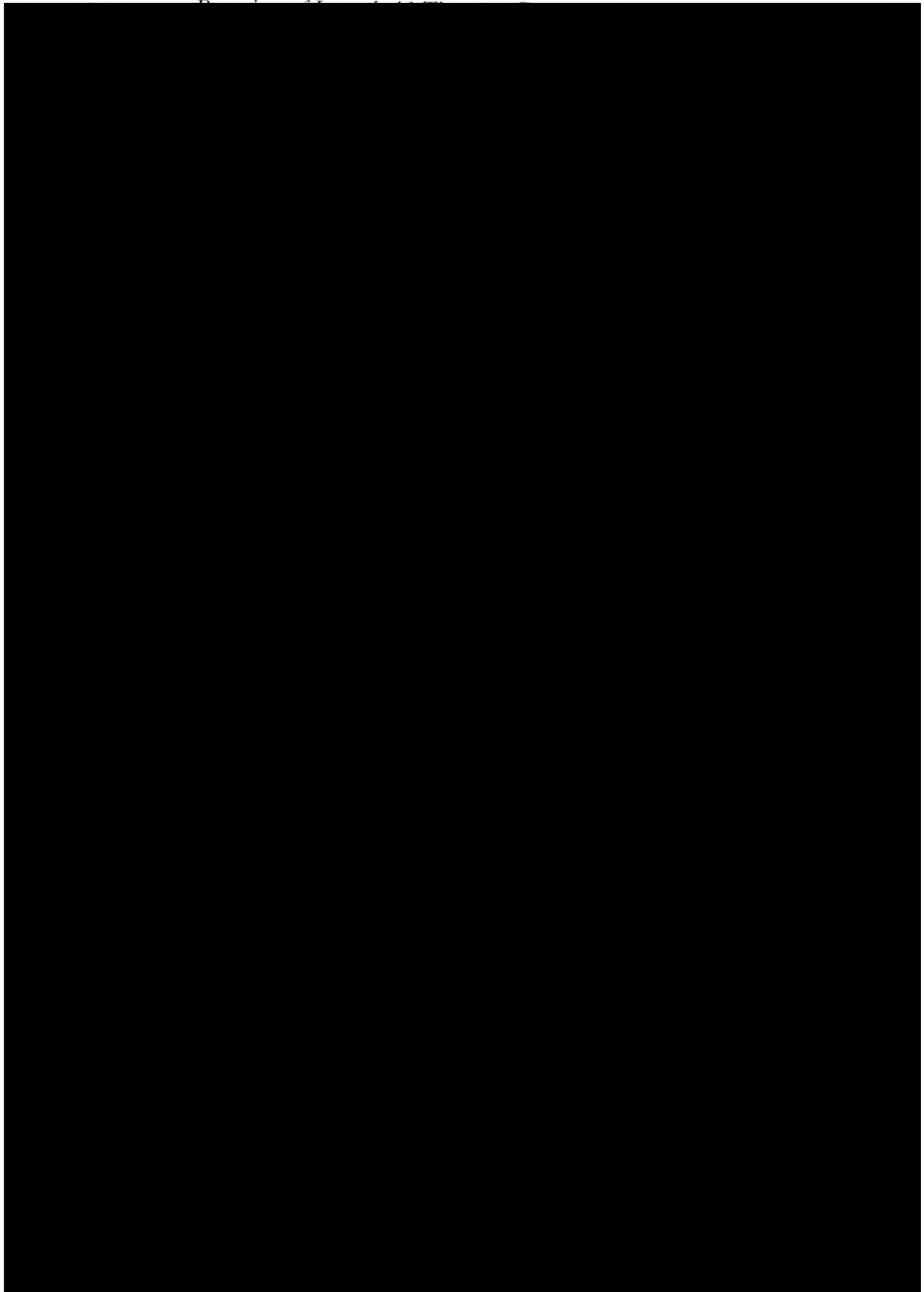


FIG. 6. Ten days after one exposure to a large roentgen dose (1 S.U.D.). There is a decrease in the germinal centers and an increase in the connective tissue.





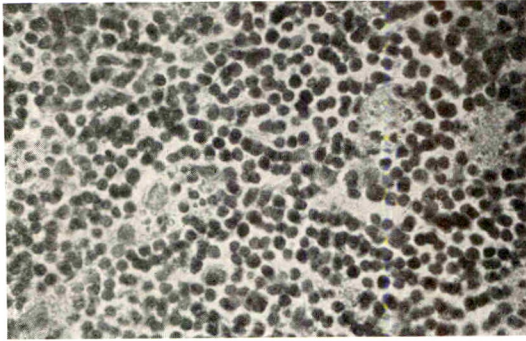


FIG. 11. Gland from control side two weeks after a course of ten daily exposures to a medium roentgen dose. Phagocytic cells are not infrequent.

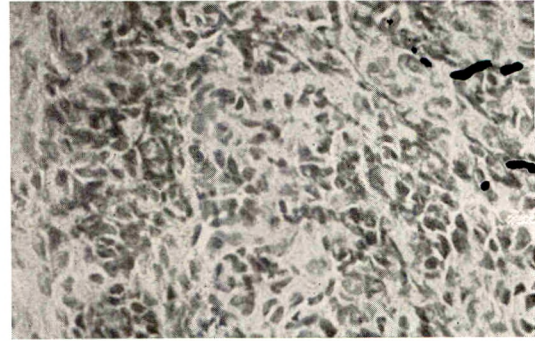


FIG. 12. Exposed lymph node three weeks after a course of ten daily exposures to a medium dose. Marked fibrosis is seen.

#### CONCLUSIONS

1. The reaction of lymphoid tissue to radiation, as demonstrated in the popliteal lymph node of a rabbit, can be divided into three periods: an early period consisting of the first twelve hours, a middle period extending from twelve hours to five days, and a late period following the fifth day.

2. In the early period are noted increase in size of the lymph node, nuclear disintegration and decomposition of the germinal centers. Accompanying this some of the phenomena of inflammation are seen,—cellular infiltration, congestion and exudation. Mitoses are seen during

this period only when a small dose of roentgen rays is used. This evidence of regeneration is not present when the large dose is used.

3. The middle interval is devoted mainly to phagocytosis and the clearing up of cellular debris.

4. At the late stage there is fibrosis of the lymph node.

5. The degree and rapidity of these above-mentioned phenomena are in proportion to the dose used.

6. On the control side the reaction is much less and much slower than on the irradiated side, although otherwise it is the same.



## COMPLICATIONS IN THE URINARY TRACT DUE TO CARCINOMA OF THE UTERINE CERVIX OR RADIATION TREATMENT\*

By HENRY SCHMITZ, M.D.

CHICAGO, ILLINOIS

CARCINOMATA of the uterine cervix may involve the urinary tract by compression, infection or invasion of either the bladder or the ureter. Radiation treatment of cervical carcinomata has apparently contributed to an increase in the frequency of urinary tract complications. Whether the primary, the secondary and the tertiary or late complications after radiation therapy result from the ravages of the carcinoma or from the action of the rays on the tissues within the field of irradiation can only be determined by a routine examination of the urinary system at the time of admission of the patient. Involvement found at this time should be attributed to the growing and invading tendencies of the malignant growths. If complications occur after the application of radiation then they may be caused by the action of the rays or result from a continuation of the destructive tendencies of a carcinoma which had not been arrested in its activities by the treatment.

Changes in the tissues caused by irradiation are characteristic and hence when exposed to view by cystoscopy, autopsy and microscopy should settle any doubt about the underlying cause of the urinary tract disturbances. Complications in the urinary tract are of frequent occurrence, cause severe symptoms, tend to chronicity and hence have become important clinical problems. A study of the underlying causes, the clinical manifestations and treatment will form the subject matter of this paper.

### COMPLICATIONS IN THE URETER AND KIDNEY

Complications arising in the upper urinary tract have been discussed by Chavan-

naz<sup>4</sup> in 1899 and Gauss<sup>6</sup> in 1904. They investigated anuria and its causes in the course of cervical carcinomata. Hunner<sup>13</sup> in 1918 considered ureteral stricture in all its phases. He considers intrinsic inflammatory changes the chief etiological factors.

In 1920 I<sup>20</sup> reported an autopsy on a patient who had been treated with radium in March, 1915, for a clinical group 2 adenocarcinoma of the cervical stump. The total dose applied was 3500 mg-el-hr.; the amount used was 50 mg. element, filtered with 1.5 mm. brass and 3 mm. paraffin. The radium capsule was inserted into the cervical canal three times for about twenty-four hours at each application, at an interval of eight days. In December, 1916, the patient returned complaining of pain in the left lower abdomen and the deep muscles of the hip and a gradually increasing difficulty in evacuation of the bowels. Examination revealed a healed cervix and a hard contracted parametrium which compressed the rectum. Urinary tract disturbances were not suspected. The patient died on March 10, 1927. Post-mortem examination revealed an almost total obstruction of the rectum, a total obstruction of the left ureter, with an enormous hydro-ureter nephrosis and a partial obstruction of the right ureter with a moderate distention of right ureter and kidney pelvis. Serial microscopic examination of all the pelvic tissues did not reveal any nests of carcinoma cells. The conclusions reached were: (1) that the urinary tract complications resulted from scar tissue formation in the parametrium due to progressive fibrosis from radium irradiation,

\* From the Departments of Gynecology, Loyola University School of Medicine, Mercy and Cook County Hospitals, Chicago, Ill. Read at the Fourteenth Annual Meeting, American Radium Society, Portland, Oregon, July 8-9, 1929.

and (2) that routine examinations of the urinary tract and rectum should be made before and after radium applications and at the appearance of pelvic pain.

Herger and Schreiner<sup>12</sup> performed 32 autopsies and investigated the condition of the bladder, ureters and kidneys in patients with cancer of the uterine cervix. Twenty-one patients showed gross pathological changes in the urinary organs. They then studied clinically 50 cases of advanced carcinomas of the cervix to determine the frequency of urinary tract lesions. On cystoscopic examination 14 cases showed definite ulceration and infiltration of the bladder mucosa in the region of the trigone. The remaining patients had elevation of the bladder wall in the same area. Ureteral catheterization and pyelography revealed obstruction with hydronephrosis in 24 cases. The authors do not state whether irradiation had been given prior to the urinary tract examinations, but conclude that the strictures resulted from pressure on the ureter due to invasion of the broad ligament or bladder wall, possibly made worse by the fibrosis resulting from radiation therapy.

Thibaudeau<sup>26</sup> reported suggestive findings revealed at autopsy in 300 patients treated by irradiation for the most part for malignancy. There were 80 carcinomas of the pelvic organs, 27 in males and 53 in females, with a total of 15 hydronephroses, or about 18.75 per cent. He concludes that hydronephrosis is a very common complication of malignancies in the pelvis. It occurs in both irradiated and non-irradiated patients. Albano<sup>1</sup> also discussed the same subject.

Götting,<sup>7</sup> in 1923, reported a case of anuria in a patient who had been treated with roentgen rays for a recurrence of a cervical carcinoma three years after a Wertheim operation. Autopsy confirmed the clinical diagnosis of occluded right ureter and patent left ureter with reflex anuria of the left kidney. Matusovszky<sup>18</sup> states that one of the most disagreeable complications of

radium-roentgen therapy is anuria from ureter compression due to shrinking processes in the parametria. He cites Simmonds who claims that pyelonephritis is the cause of death in 5 per cent of cervical cancers, and Busse, who found disturbances of the urinary tract without injury to the ureters after panhysterectomy in 50 per cent and pyelitis and pyelonephritis in 25 per cent of the patients. Matusovszky reports a case of anuria after radium application lasting six days. It was successfully treated with indwelling catheters.

Martin and Rogers<sup>15</sup> in animal experimentation found that a radium dose of 75 mg-el-hr. placed alongside the ureter will cause complete constriction, while 50 mg-el-hr. will cause a partial constriction. The procedure of blindly inserting radium needles or radon seeds into the paracervical tissues is hazardous as the ureters may become obstructed. Transplantation of the ureters or ureterostomy should render the implantation plan of attack relatively safe. Martin<sup>16</sup> in a later contribution describes the symptoms and treatment of ureteral obstruction. The prophylaxis consists in a proper irradiation technique. Stress is laid on a broad ligament roentgen irradiation, which frequently abates ureteral obstruction. Dilatation of ureter, indwelling catheter, ureteral transplantation, ureterostomy and nephrostomy are the other methods advised for the relief of these conditions.

#### CLINICAL DISCUSSION

Complications in the ureter and kidney may be produced in three ways: (1) Infections, such as cystitis, pyometra, tubo-ovarian abscess, para- and perimetritis may by ascension and direct extension cause ureteritis, pyelitis, pyonephritis and pyonephrosis. (2) Irradiation may compress or obliterate the lumen of the ureter. Compression may result from scar tissue formation in the parametria, while occlusion may be caused by the insertion of radium needles.



dles or gold filtered radon seeds in the paracervical connective tissue. The result will be hydro-ureter and hydronephrosis and, if infection ensues, pyelitis and pyelonephritis. (3) The carcinoma, if still active, may invade the ureteral wall. Such a condition is rare but many authentic instances have been reported. An active carcinoma involving the parametrium may by compression from without cause ureteral stricture with hydro-ureter and hydronephrosis, and, if an infection coexists, pyelitis and pyelonephritis.

The onset of ureter and kidney complications varies, depending on the existence of infection or cancer compression at the time of admission of the patient, or on faulty irradiation technique, or on fibrotic changes in the parametrium caused by radium. If the complication is caused by a local action of the rays on the ureter, then the symptoms will appear soon after treatment; if it results from fibrosis then months and years may pass; if it results from an infection actuated by the local instrumental manipulation incident to radiation therapy, then the onset takes place almost immediately and often during the treatment.

The symptoms are a constant dull and often acute pain in the affected side. It is usually referred to the loin, or to the pelvis, or to the site of obstruction and trauma or to the sacroiliac synchondrosis. The pain radiates outward into the muscles of the buttocks, downward into the thigh, simulating a sciatica, and upwards to the region of the kidney. Nausea and vomiting may be observed. Disturbances of urination are usually lacking. If infection coexists the patient may experience an initial rigor, pyrexia, anorexia and prostration. The examination of the urine is negative, unless cystitis, ureteritis or pyelitis is present. The urine then is cloudy, contains pus and blood corpuscles and albumin. Examination of the blood reveals a leucocytosis and neutrophilia. The erythrocyte sedimentation test<sup>23</sup> cannot help in the diagnosis as

the sedimentation time is almost invariably accelerated in patients suffering from carcinoma.

Ureteral catheterization and pyelography render the diagnosis positive. The insertion of a ureteral bulb bougie into the ureter and the elicitation of a "hang" on withdrawal is pathognomonic for stricture but is absent in obstruction due to compression.

The differential diagnosis should include pyometra, tubo-ovarian abscess, pelvic peritonitis and cellulitis, metastases in the spine, pelvic bones and liver and sacroiliac arthritis.

The treatment should be prophylactic, palliative and curative. Prophylaxis consists in avoiding (1) over-irradiation or repetition of a complete series of irradiation at too early a time; (2) implantation of radium needles and radon seeds unless catheters have been placed in the ureters and the latter are then palpable, and (3) placing radium capsules in the vaginal vaults unless they are highly filtered and maintained at a definite distance by the use of phantoms prepared from cork or bakelite.<sup>22</sup> Dean<sup>5</sup> states that 3500 mg-el-hr. should be considered as bordering on the upper limit of safety. We recommend the intracervical application of 50 mg. radium element filtered with 1.5 mm. brass and 3 mm. paraffin in three interval applications of twenty-four to thirty hours every eight to tenth day. The rectum and bladder must be protected by firmly distending the vaginal canal with gauze sponges. The rectum and bladder should be kept empty by catharsis, enemas and retention catheters. To the radium dose, a roentgen dose of 600 to 800 r may be added to insure a proper radiation dose at the bony periphery of the pelvis, the site of the regional lymph nodes.

If infections of the bladder, the uterus and the adnexa are present, then they must be treated and healed first before irradiation is begun. Normal temperature, normal leucocyte count, absence of pelvic pain when the cervical cancer is still movable,

and a negative virulence test according to Ruge-Philipp<sup>3</sup> are the criteria by which an absence of a complicating infection may be determined.

Dilatation from the vesical approach is the ideal treatment. If the structure is bilateral then one side only should be dilated at a time. The dilatation should be done gently and gradually. It should not be repeated before a lapse of ten days or until the traumatic edema has subsided. If an infection coexists then lavage of the pelvis through an indwelling catheter with a 1:2000 solution of silver nitrate is recommended. The internal administration of salol, urotropin, acriflavin, or caprokol is of value. The symptoms of obstruction and infection may be entirely cleared up under such treatment. In other cases with infection and large kidney pelvis one may not be able to combat the infection and obstruction entirely but may restore the patient to apparent health.

If all methods of conservative treatment have failed, and if the carcinoma has been definitely arrested or controlled by the irradiation, then operation is indicated. The choice of operation depends on the circumstances presented and may be extirpation, pyelotomy, or ureteral transplantation.

#### COMPLICATIONS IN THE BLADDER

In irradiation of the pelvic organs a more or less intense radiation dose is applied to the urinary bladder. Reactions in the bladder wall are caused by either too high a dose or an idiosyncrasy of the patient. As stated in the beginning paragraph, invasion of the bladder by an extension of a cervical carcinoma is of frequent occurrence. Beckmann found vesico-vaginal fistulae in about 15 per cent, fecal fistulae in 6 per cent, and recto-vesico-vaginal fistulae in about 3 per cent. Zangemeister<sup>27</sup> in 1901 discussed the changes in the bladder associated with cervical carcinomata. Gouverneur and Fabre<sup>8</sup> examined routinely the bladder in 200 cases of cervical carci-

noma before and after radium application. Injury to the bladder by radium is negligible. If an inflammation existed before the beginning of radiation treatment then an increase in the symptoms, namely, tenesmus and pollakiuria, should be expected. If ulcers are present in the bladder wall extreme caution should be used in applying radium. They did not see a single vesico-vaginal fistula.

Marzetti<sup>17</sup> states that the most frequent cystoscopic finding is elevation of the bladder floor, the "bombement" of the French. The mucosa is found intact if the cancer has not as yet invaded the bladder wall. In advanced cervical carcinomas punctiform hemorrhages, dilated blood vessels, and reddening of the mucosa are seen. The development of bullous edema means cancer invasion and contraindicates surgical treatment. The terminal changes in the bladder in their sequence are formation of nodules, papillary proliferations, small ulcerations, coalescence of these to form a large ulcer, loss of tissue by necrosis and finally vesico-vaginal fistula.

The changes observed in the bladder after radiation therapy of cervical carcinomata have been discussed by the writer,<sup>21</sup> Heimann,<sup>11</sup> Dean,<sup>5</sup> and others. Dean divides the reactions into: (1) a primary erythema occurring within twenty-four hours; (2) a secondary erythema seen approximately from twenty-one to twenty-eight days later which is caused by a temporary vasomotor paralysis, and (3) a tertiary reaction, which is a late complication and rarely seen before the lapse of one year. He cites 3 cases of bladder ulcers occurring fourteen and a half to twenty-four months after irradiation. The symptoms were frequent and painful urination, especially at the end of the act, and presence of blood in the urine. There may be an offensive odor to the urine. The cystoscopic examination revealed an ulceration of the posterior wall usually beginning just above the trigone. The surrounding mucosa is acutely inflamed. There is a suggestion of a contractural

area in the periphery of the ulcer. The ulcer is impregnated with a gritty deposit. Microscopic examination of the tissue is necessary to differentiate it from cancer. The author states that 3500 mg-el-hr. of radium applied intracervically should be considered a dose bordering on the upper limit of safety.

Schugt<sup>24</sup> reports a case of vesical hemorrhage after radium and roentgen irradiation. The patient had benign uterine hemorrhages for which she received a roentgen castration dose. The hemorrhages did not cease and two months later an intrauterine radium application was made without any benefit, and one year later a second roentgen castration dose was given. The hemorrhages, however, continued. Cystoscopy revealed a nodule in the fundus the size of a pea. A histological examination showed a varix or telangiectasis, which was attributed to the irradiation. Apparently cystoscopic examinations made before this would have proved this contention. Auvray<sup>2</sup> saw a patient who had a squamous cell cancer of the cervical stump which was treated with a pallisade of 800 mg-el-hr. of unfiltered radium in the paracervicum, with 1440 mg-el-hr. of filtered radium intracervically and with a roentgen dose of 2000 R (Solomon). Eight weeks later a vesico-vaginal fistula had formed. Five years later the patient was found free from carcinoma and the fistula was successfully closed surgically.

Ottow<sup>19</sup> reports a case treated with roentgen rays. Six months afterwards an ulcer formed in the abdominal wall which gradually extended deeper and wider. Necrosis caused loss of tissue in the abdominal wall, then sequestration of part of the pubic bone, and finally nine years later a fistula in the vortex of the bladder. Heidler<sup>10</sup> warns against the dangers of prophylactic radium irradiation after a Wertheim operation. He reports a case that was treated with 4000 mg-el-hr. Eight months later a recto-vaginal fistula had formed and nine years afterwards a recto-vesical fistula ap-

peared. Handorn<sup>9</sup> reports two cases of late bladder ulcers nine and a half months and one and a half years after radium treatment. The doses applied were four times as large as used in this country for similar pathology. Stacy,<sup>25</sup> also, describes the late occurrence of trophic ulcers of the bladder. Schmitz and Laibe, in a recent paper, have discussed the clinical and diagnostic aspects of urinary tract complications in pelvic carcinomata treated with irradiation.

#### CLINICAL DISCUSSION

Irradiation cystitis, the secondary erythema of Dean, usually appears from twenty-one to twenty-eight days after treatment. It is characterized by painful and frequent urination and a feeling of dull burning pain in the region of the bladder. Cystoscopic examination reveals a generalized edema and a deep red discoloration of the vesical mucous membrane. Tolerance of the bladder is decreased.

Irradiation cystitis depends on the total radiation dose given. It increases in severity with an increase in the dose applied. If pathological changes were present before irradiation, then the tissues offer a lessened resistance to the action of the rays and the resulting irradiation cystitis is correspondingly severe. If the bladder is diseased then it should be treated first before irradiation is applied. Carcinomatous invasion of the bladder from a cervical carcinoma contraindicates radium treatment; roentgen rays, however, may be used.

The cystitis is treated by lavage with boric acid solution until the washings return clear. Hyoscyamus, sodium citrate, lithium benzoate, lithium citrate are given internally. The condition is self-limited and subsides with conservative treatment within three to six weeks.

The late complications in the bladder after radiation therapy, the tertiary reactions of Dean, rarely occur before one to two years. They correspond to the irradiation indurations seen in the skin exposed to rays. The same dose may safely be applied



to a large number of patients; yet here and there a patient will show latent tissue indurations. If the irradiation technique was perfect one must assume that such patients possess a lessened resistance to the rays, a true idiosyncrasy.

The onset is insidious. The patient may be aware of a sense of tightness in the depth of the pelvis. Gradually discomfort is felt on urination. It increases in intensity until dysuria and pollakiuria are extreme. The urine may contain blood, gritty deposits and tissue shreds depending entirely on the degree of development of the irradiation induration into an irradiation ulcer.

Cystoscopic examination reveals a glistening white mucosa with fissures and with a sparse supply of blood vessels. The posterior bladder wall has lost its elasticity; it is scarred, firmly fixed to the uterus, streaked with telangiectases. Small indolent ulcers may be seen covered with urinary salts. The tolerance of the bladder is decreased because the posterior bladder wall cannot slacken, it is firmly adherent to the adjacent organs and is fibrous. As time goes on the small ulcers increase in size, necrosis takes place, and as a terminal step, sloughing of the indurated area with the formation of fistula renders the picture complete. It is the same process seen in the skin: induration with telangiectasis, ulceration, necrosis, sloughing.

Should similar changes occur in the rectal wall, then obliteration of the vaginal lumen occurs. The final changes in the rectum are the same as in the bladder and the ultimate result may be a vesico-rectal fistula. The consequence is a severe infection of the bladder.

The differential diagnosis must consider an active carcinoma. Microscopic examination will render a positive diagnosis.

The treatment must be conservative. Obviously the avoidance of over-irradiation and repeated irradiation with a full dose are the only means to prevent such tertiary reactions.

Local irritation must be avoided. The

administration of hyoscyamus, lithium benzoate, lithium citrate, or sodium citrate is beneficial. Lavages with boric acid solution tend to remove the gritty deposits and tissue debris. Hot baths may relieve the local distress.

If the trophic ulcer should break down, then surgical intervention is indicated, if the cancer has been completely arrested. Surgical repair or excision is not advisable. The process is, as a rule, a progressive one; the surgeon cannot decide from macroscopic examination whether or not he is working in normal tissue. Tissues damaged by irradiation heal poorly, if at all. The best possible relief is obtained by transplantation of the ureters into the sigmoid if the rectum is normal.

In a case of recto-vesical fistula following irradiation given in 1914 that came under our care a colostomy was performed. The urine receptacle now consists of bladder and rectum. The patient feels comfortable and is indeed grateful. The bladder has cleared up and the hemorrhages have ceased.

#### CONCLUSIONS

1. Complications in the urinary tract of women suffering from cervical carcinoma are frequent. They may result: (1) from an extension of the primary cancer; (2) from pelvic infections associated or complicated with the carcinoma, and (3) from the action of the rays, if the technique of application was faulty or if the tissues possessed a lessened resistance or idiosyncrasy to radiation.

2. The complications may be divided into: (1) primary, occurring at the time of treatment; (2) secondary, appearing within twenty-one to twenty-eight days after treatment, and (3) tertiary, developing some years after treatment.

3. The complications arising in the ureter and kidney have been discussed and methods for prophylaxis and treatment have been given.

4. The complications occurring in the bladder are frequent and are usually caused

by the primary cancer, though late irradiation complications are seen which very frequently result from untimely and faulty technique. The treatment has been discussed.

Routine examinations of the urinary tract before and after irradiation are recommended to avoid unnecessary compli-

cations in the urinary tract from radiation therapy for carcinoma of the uterine cervix.

6. It is evident that some patients possess a true idiosyncrasy to rays. It is probable that a great number of late complications may be explained on this basis if the technique of irradiation has been correct.\*

## REFERENCES

1. ALBANO, G. Idronefrosi da invasione cancerica dell'uretere pelvico. *Riv. ital. di ginecol.*, 1927, 5, 641.
2. AUVRAY. Cancer du col utérin guéri par le radium depuis près de cinq ans. *Bull. et mêm. Soc. nat. de chir.*, 1927, 53, 571-576.
3. BUMM, ERNST. Operative Gynäkologie. J. F. Bergmann, München, 1926.
4. CHAVANNAZ. Anurie par cancer de l'utérus. *Gaz. hebdomadaire de méd.*, 1899, 4, 437.
5. DEAN, A. L. JR. Ulceration of urinary bladder as late effect of radium applications to uterus. *J. Am. M. Ass.*, 1927, 89, 1121-1124.
6. GAUSS, C. J. Über die Ursachen der Anurie. *Festschr. f. Orth.*, 1924.
7. GÖTTING, FRITZ. Anurie nach Uteruscarcinomrezidiv. *Zentralbl. f. Gynäk.*, 1923, 47, 321-322.
8. GOUVERNEUR, R., and FABRE, S. Les lésions de la vessie dans le cancer de l'utérus avant et après radium thérapie, à propos de 200 cas. *Bull. Soc. d'obst. et de gynec.*, 1924, 13, 782.
9. HANDORN. Ulcus incrustatum der Harnblase als Spätschädigung nach Strahlentherapie. *Zentralbl. f. Gynäk.*, 1928, 52, 507-510.
10. HEIDLER, HANS. Cystitis dissecans gangraenescens (Stoeckel) actinogenetica. *Ztschr. f. Geburtsh. u. Gynäk.*, 1927, 92, 1-13.
11. HEIMANN, FRITZ. Die Blasenveränderungen beim bestrahlten Gebärmutterkrebs. *Zentralbl. f. Gynäk.*, 1927, 51, 1899-1905.
12. HERGER, C. C., and SCHREINER, B. F. Strictured ureters, hydronephrosis and pyonephrosis occurring in cancer of the cervix uteri. *Surg., Gynec. & Obst.*, 1926, 43, 740-743.
13. HUNNER, G. L. Ureteral stricture; report of 100 cases. *Johns Hopkins Hosp. Bull.*, 1918, 29, 1-15.
14. MARTIN, C. L. Broad ligament extension in carcinoma of the cervix. *Am. J. Roentgenol. & Rad. Therapy*, 1926, 15, 336-344.
15. MARTIN, C. L., and ROGERS, F. T. The effect of irradiation on the ureter. *Am. J. Roentgenol. & Rad. Therapy*, 1926, 16, 215-218.
16. MARTIN, C. L. Ureteral stricture as complication in cancer of the cervix. *J. Am. M. Ass.*, 1928, 91, 1537-1541.
17. MARZETTI, V. Le alterazioni della vesica nel cancro del collo dell'utero. *Clin. ostet.*, 1926, 28, 350-356.
18. MATUSOVSKY, A. Über einen Fall sechstägiger Anurie infolge Radiumbestrahlung. *Monatsschr. f. Geburtsh. u. Gynäk.*, 1923-1924, 65, 299-306.
19. OTTOW, B. Blasen-Bauchdeckelfistel mit Nekrose des Schambeines infolge einer Röntgenverbrennung. *Zentralbl. f. Gynäk.*, 1927, 51, 2936-2943.
20. SCHMITZ, HENRY. The classification of uterine carcinoma for the study of the efficacy of radium therapy. *Am. J. Roentgenol.*, 1920, 7, 383.
21. SCHMITZ, HENRY. Clinical significance and treatment of radiation sickness. *Radiology*, 1924, 2, 137-142.
22. SCHMITZ, HENRY. The treatment of cervical carcinomata with measured doses of x-rays and radium based on microscopic examinations. *Am. J. Obst. & Gynec.*, 1925, 9, 644-658.
23. SCHMITZ, HENRY, and SCHMITZ, HERBERT. The sedimentation test in pelvic diseases of the female. *Am. J. Obst. & Gynec.*, 1926, 11, 353-360.
24. SCHUGT, Paul. Über einen bemerkenswerten Fall von Blasenblutungen nach Röntgen-Radiumbestrahlung. *Zentralbl. f. Gynäk.*, 1923, 47, 1862-1868.
25. STACY, LEDA J. Complications following the application of radium to pelvic lesions. *Am. J. Roentgenol. & Rad. Therapy*, 1928, 19, 323-327.
26. THIBAUDEAU, A. A. Suggestive findings revealed at autopsy in patients treated by radiation. *J. Cancer Research*, 1929, 13, 66-72.
27. ZANGEMEISTER, W. Blasenveränderung bei Portio und Cervikalkarzinom, 1901. Veit's Handbuch der Gynäkologie, J. F. Bergmann, Wiesbaden, 1907.

\* For discussion see page 59.

# RESULTS OBTAINED IN THE TREATMENT OF CARCINOMA OF THE CERVIX UTERI WITH RADIUM AND ROENTGEN RAYS FROM 1915 TO 1923, INCLUSIVE\*

By HARRY H. BOWING, M.D., ARTHUR U. DESJARDINS, M.D., LEDA J. STACY, M.D., and J. HERBERT BLISS, M.D.

*Sections on Radium and Roentgen-ray Therapy and Division of Medicine, The Mayo Clinic  
ROCHESTER, MINNESOTA*

**D**URING the period between 1915 and 1924 inclusive, 981 cases of carcinoma of the cervix uteri were treated with radium and roentgen rays at The Mayo Clinic. In this same period 136 cases of carcinoma of the uterine cervix were seen, but treatment was not applied. Operation had been performed or treatment by irradiation had been instituted elsewhere in 52 of these cases. In 129 cases operation or treatment by the Percy cautery was carried out at the Clinic.

In the early years, the diagnosis was made on the basis of history and general examination and, in selected cases, on operative data. In later years, these methods were substantiated by the removal of bits of tissue for microscopic study.

To facilitate the presentation of our material, a series of tables was prepared. The classification used in previous publications of similar cases has been adhered to and is based chiefly on the anatomic distribution of the disease at the time the case first was observed.

Four groups of cases were encountered: operable, borderline, inoperable, and modified. The age incidence is shown in Table I according to groups. The modified and inoperable groups include sufficient numbers to furnish a reliable estimate, showing clearly that the disease occurs most frequently during or near the age of the menopause. Although the borderline and operable groups are small, yet the average age is greater. Observation teaches us that the

TABLE I  
AGE INCIDENCE

Age, years	Modified group		Inoperable group		Borderline group		Operable group	
	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent
20-24			1	0.18				
25-29	12	2.79	8	1.48				
30-34	52	12.12	22	4.09				
35-39	59	13.75	57	10.61	1	7.69		
40-44	79	18.41	78	14.52	1	7.69		
45-49	71	16.55	98	18.24	2	15.38	1	50.00
50-54	72	16.78	96	17.87	3	23.07		
55-59	50	11.65	83	15.45	3	23.07	1	50.00
60-64	25	5.82	53	9.86	1	7.69		
65-69	7	1.62	30	5.58	1	7.69		
70-74	2	0.46	8	1.48	1	7.69		
75-79			3	0.55				
Total	429		537		13		2	
Average age, years	46.15 ± 0.3		50.33 ± 0.29		54.4 ± 1.6		52.5 ± 2.4	

\* Read at the Fourteenth Annual Meeting, American Radium Society, Portland, Oregon, July 8-9, 1929.



TABLE II  
SURVIVORS OF ALL GROUPS BY YEARS

Year treated	Total cases	Years of postoperative life of various number of patients*												
		1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928
1915	5	1	1	1	1	<b>1</b>	1	1	1	1	1	1	1	1
1916	63		23	14	10	7	<b>5</b>	5	5	5	5	5	5	5
1917	93			50	27	21	18	<b>17</b>	13	12	11	9	8	8
1918	135				62	40	26	20	<b>16</b>	15	10	8	6	6
1919	145					77	44	33	20	<b>18</b>	16	14	11	9
1920	151						84	58	42	38	<b>37</b>	31	28	27
1921	118							62	51	46	39	<b>39</b>	35	34
1922	136								71	52	39	30	<b>28</b>	25
1923	135									81	60	50	42	<b>41</b>

\*The boldface figures indicate the numbers of patients living five years after treatment.

older patients do not have, as a rule, bulky or heavily infiltrating lesions; therefore, from an anatomic point of view great care must be exercised in grouping them. The extent of the primary neoplasm is best ascertained by inspection, with the patient in the knee-chest position; the chance for error in grouping is greater in older patients.

In Table II the survivors of all groups were classified according to the year in which treatment was given. The number of patients living five years after treatment was taken as the significant figure. In 1920 this figure rose sharply. The number of survivors after five years of those patients treated in 1920 is almost 100 per cent greater than the corresponding number of survivors among those who were treated in the three years preceding 1920. There are many contributing factors to be considered, however, of which greater individualization in treatment with radium is the most outstanding. A careful bimanual pelvic examination, and placing the radium applicators while the patient is in the knee-chest position, furnishes the best means of selecting those factors in treatment which are necessary to meet the needs of the patient under consideration.

Data concerning groups of the treated and traced patients giving the results fol-

lowing the third and fifth years after treatment were given and when possible following the seventh and tenth years (Table III). Returns or positive information concerning 898 patients, 91.53 per cent of the total of 981 patients, are recorded. The modified group shows that 122 patients (31.20 per cent) are living after three years, and that 95 patients (24.29 per cent) are living after five years, whereas the figures for the inoperable group are slightly lower; 138 patients (27.83 per cent) are alive at the end of the three year period, and 99 patients (20.04 per cent) are alive at the end of the five year period. Probably the most suggestive factor to be considered is that of the extent of the primary lesion. It seems reasonable to assume that the patients in the modified group, when first seen, did not have the extensive local involvement and the usual break in general health which is so common with patients in the inoperable group. In other words, the disease was arrested earlier in its development when the health of the patient was good. The number of patients in the operable and borderline groups is too small for comparison; however, it is evident that this group can expect much from efficient irradiation devoid of the risk usually assumed when surgical intervention is carried out.

TABLE III  
CLASSIFICATION OF PATIENTS TREATED AND TRACED BY GROUPS

Group	Year	Total cases	Pa-tients traced	Lived 3 years		Lived 5 years		Lived 7 years		Lived 10 years	
				Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent
Modified	1915	4	4	1	25.0	1	25.0	1	25.0	1	25.0
	1916	39	38	8	21.05	4	10.52	4	10.52	4	10.52
	1917	55	53	17	32.07	15	28.30	11	20.75	7	13.20
	1918	69	61	16	26.22	9	14.75	6	9.83	3	4.91
	1919	59	54	15	27.75	11	20.37	7	12.96		
	1920	60	53	21	39.62	19	35.84	15	28.30		
	1921	36	31	11	35.48	9	29.03	7	22.58		
	1922	59	54	16	29.62	13	24.07				
	1923	48	43	17	39.53	14	32.55				
	Total	429	391	122	31.20	95	24.29	51	13.04	15	3.83
Inoperable	1915	1	1								
	1916	24	24	2	8.33	1	4.16	1	4.16	1	4.16
	1917	38	34	4	11.76	2	5.88	1	2.94	1	2.94
	1918	65	59	10	16.94	7	11.86	4	6.77	3	5.08
	1919	85	84	18	21.42	7	8.33	7	8.33		
	1920	89	78	20	25.64	17	21.79	12	15.38		
	1921	74	66	30	45.45	25	37.85	22	33.33		
	1922	76	68	22	32.35	14	20.58				
	1923	85	80	32	40.0	26	32.50				
	Total	537	494	138	27.83	99	20.04	47	9.51	5	1.01
Borderline	1918	1	1								
	1919	1	1								
	1921	8	7	5	71.42	5	71.42	5	71.42		
	1922	1	1	1	100.0	1	100.0				
	1923	2	2	1	50.0	1	50.0				
	Total	13	12	7	58.33	7	58.33	5	41.66		
Operable	1920	2	1	1	100.0	1	100.0	1	100.0		
Grand Total		981	898	(91.53 per cent)							

The five-year cures are grouped under three divisions in Table IV according to the patients treated by irradiation and the patients traced following the treatment. When the totals of all groups encountered are added together there are 981 treated patients of whom 898 were traced. Two hundred and two are known to be alive five years or more after treatment; that is, 20.59 per cent of those who were treated, and 22.49 per cent of those who were traced. Some authors do not include the

modified group in their reports. With this group omitted there is a total of 552 patients who were treated, of whom 508 were traced. One hundred and seven patients are known to be alive for five years or longer after treatment; that is, 19.38 per cent of those who were treated, and 21.06 per cent of those who were traced. Only 15 patients were treated in the operable and borderline groups combined, 13 of whom were traced. Of these, 8 patients are known to be alive for five years or

TABLE IV  
FIVE-YEAR CURES BY GROUPS

Group	Treated by radium, cases	5-year cures	Per cent	Patients traced	5-year cures	Per cent
Operable, inoperable, borderline, and modified	981	202	20.59	898	202	22.49
Operable, inoperable, and borderline	552	107	19.38	508	107	21.06
Operable and borderline	15	8	53.33	13	8	61.53

longer after treatment; that is, 53.33 per cent of those who were treated, and 61.53 per cent of those who were traced.

The cases were studied according to the length of life by grading of the pathologic change (Table v) as reported by the pathologist from the observation made of the bit of tissue usually removed from the primary tumor at the time of the first application of radium. However, biopsy was not the practice with the earlier patients treated, as shown by the data furnished. Of the total of 981 patients, material for study was available in only 545 cases. Epithelioma was reported in 496 cases, 90 per cent of the cases in which report of biopsy was available. Adenocarcinoma was reported in 42 cases (7.70 per cent). In 7 cases (1.28 per cent) both epithelioma and adenocarcinoma were found in the material sent in for study. These figures furnish a total of 545 cases; of these, 501 were graded according to Broders' method of grading. The number of carcinomas graded 1 and 2 gave a total of 88 cases (17.56 per cent) on the basis of 501, whereas the number of tumors graded 3 and 4 gave a total of 413 (82.43 per cent). This shows rather clearly that the growths of high-grade malignancy predominate in the cases of carcinoma of the cervix uteri. The report made by the pathologist is of great value to the radiologist, especially in

planning the initial as well as the future treatment of the patient. However, there is a great chance for much confusion in including such data in a study of this kind. Broders found that surgical operation would produce good results in epitheliomas graded 1 and 2, whereas in those graded 3 and 4 results from surgical operation were poor. This is not the experience of the therapeutic radiologist in the treatment of cases of carcinoma of the uterine cervix, as shown in Table vi. The patients who lived three and five years are grouped according to grade of pathologic change. The epitheliomatous lesions graded 3 and 4 are in sufficient numbers to justify the statement that slightly more than a third of the patients are alive at the end of the three-year period. The borderline group is small; however, similar lesions showed that 71.42 per cent of the patients with lesions graded 3 and 4 are alive at the end of the fifth year. The adenocarcinomas, also, are few in number; however, it can be safely stated that they do respond to irradiation and the results are equal to and may exceed those in epithelioma.

The hospital mortality rate is shown in Table vii. The risk occurs in the modified and inoperable groups and a careful analysis of the deaths shows that the danger was not in the effects of the treatment applied, but in the destructive processes of the malignant disease. If it had been possible to determine this state of affairs before the treatment was applied, it would have been grossly obvious that treatment by irradiation was contraindicated.

#### SUMMARY

This report deals primarily with the cases treated in the early years of the establishment of treatment by irradiation at The Mayo Clinic.

The immediate and late results are very gratifying when compared with the results obtained with the previous surgical methods. Further, the lack of the mortality and morbidity features attending opera-



TABLE V  
CLASSIFICATION OF LENGTH OF LIFE BY GRADE OF PATHOLOGIC CHANGE

Group	Microscopic diagnosis	Total cases	Unable to trace	Died within 1 year	Died, time not stated	Length of life, years					
						3	5	6	7	9	10
Modified	Epithelioma, not graded	26	4	1	2	13	10	8	7	5	3
	Epithelioma, graded 2	29	3	5	3	9	8	6	5	4	4
	Epithelioma, graded 3	99	5	21	11	39	27	17	10	4	1
	Epithelioma, graded 4	65	4	21	9	17	13	9	9	3	3
	Adenocarcinoma, not graded	5	1	1		3	2	2	1	1	1
	Adenocarcinoma, graded 1	3				2	2	1	1		
	Adenocarcinoma, graded 2	11		1		5	5	4	3	1	
	Adenocarcinoma, graded 3	5				4	4	3	3	1	1
	Adenocarcinoma, graded 4	1				1	1	1			

TABLE VI  
THREE-YEAR AND FIVE-YEAR CURES BY GRADE OF PATHOLOGIC CHANGE

Group	Microscopic diagnosis	Total cases	Patients traced	Lived 3 years	Per cent	Lived 5 years	Per cent
Modified	Epithelioma, graded 2	29	26	9	34.61	8	30.76
	Epithelioma, graded 3 and 4	164	155	56	36.12	40	25.8
	Adenocarcinoma, graded 1 and 2	14	14	7	50.0	7	50.0
	Adenocarcinoma, graded 3 and 4	6	6	5	83.33	5	83.33
Inoperable	Epithelioma, graded 2	32	28	10	35.71	6	21.42
	Epithelioma, graded 3 and 4	226	212	76	35.84	60	28.30
	Adenocarcinoma, graded 1 and 2	11	11	6	54.54	4	36.36
	Adenocarcinoma, graded 3 and 4	4	4				
Borderline	Epithelioma, graded 3 and 4	7	7	5	71.42	5	71.42

tions in this field makes the treatment all the more acceptable. It can be relatively safely stated that the patients in the modified group were beyond help by further surgical operation and that those in the inoperable group were too far advanced in disease for any type of operation. Yet irradiation has brought about much palliation

in practically all cases treated and has saved one-third of the patients for a period of three years. Experience in this field of treatment warrants the statement that better results will be possible in the future and especially so if it is possible to see patients soon after the onset of the disease.

TABLE VII  
HOSPITAL MORTALITY RATE

Group	Total cases	Hospital mortality	Per cent
Modified	429	5	1.16
Inoperable	537	6	1.11
Operable	2		
Borderline	13		

Probably the best means at our disposal is the education of women to report irregular vaginal discharge immediately, as well as education of the physician to appreciate the significance of these signs and to examine the patient and institute proper measures at once. The periodic general examination should do much to bring about this desirable feature in the management of cases of carcinoma of the uterine cervix.

#### REFERENCES

1. BOWING, H. H., and FRICKE, R. E. Radium treatment of carcinoma of the cervix during 1927. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1929, 21, 529-537.
2. BRODERS, A. C. Squamous cell epithelioma of

the lip. *J. Am. M. Ass.*, 1920, 74, 656-664.  
Squamous cell epithelioma of the skin. A study of 256 cases. *Ann. Surg.*, 1921, 73, 141-160. Epithelioma of genito-urinary organs. *Ann. Surg.*, 1922, 75, 574-604.

#### DISCUSSION ON PAPERS OF DRS. SCHMITZ, AND BOWING ET AL.

DR. ROLLIN H. STEVENS, Detroit, Mich. Dr. Schmitz and Dr. Bowling used the word "inoperable" in a way which I think is a little confusing, yet we all use it in the same way. What is an inoperable cancer? It is not only the fixed, frozen pelvis, but also Broders' grade 3 or 4 are exceedingly malignant cancers,

and I think most authorities will agree that they too are inoperable. This would probably have some bearing on the discussion in regard to Dr. Bowling's modified cases.

Dr. Bowling stated that his excellent results were obtained because of a definite technique which he follows, namely knee-chest position,

etc. It is very probable that it is not the particular position in which the patient is placed during the application of radium but that the radium after being placed gives a very much better distribution of the radiation in vagina and to the parametrium which accounts for his most excellent results. I am not certain whether Dr. Bowing wishes to leave the impression that every case is treated for the same length of time with the same amount of radium. It seems to me that there would be other factors which would influence the results, such as the type of growth, the amount of infiltration, and the length of time that the radium is used, as well as the amount of radium.

In connection with the late lesions as pointed out in Dr. Schmitz' paper, some five or six years ago I remember Professor Forssell, in discussing a paper before one of the Scandinavian radiological societies, stated that he had seen only 2 or 3 cases of late necrosis develop after irradiation, and in those cases the patients were always syphilitic. I think we cannot consider these cases as all due to syphilis, but it is quite probable, according to the experience of many men, that infections play an important rôle in the production of the late radionecrosis. This would lead us to the importance of eradicating as much of the infection in the genitourinary tract as possible, as Professor Regaud tries to do, before beginning the radium treatment. The infection certainly lowers the resistance of the tissues. There may not necessarily be a lowered resistance to cancer and yet the infection in the tissue may be the traumatic insult that is responsible for the later development of cancer. If the tissue is already diseased, if the blood vessel walls are thickened and the connective tissue increased, it can be seen that treatment which increases this difficulty would later on lead to radionecrosis.

DR. R. E. LOUCKS, Detroit, Mich. Dr. Bowing's suggestion a few years ago about giving the treatment in the knee-chest position was timely for many of us. Since he first mentioned this, nearly all of my uterine cases have been treated in that way, especially if the rectal examination reveals anything suspicious, such as infiltration in the parametrium. It is convenient to treat in the knee-chest position; but I treat in the perineal position when there is a nodule involving the bladder

wall. Unfortunately, all of these cases have a prolapsed bladder wall and there is rectocele and all sorts of things that we have to protect against with our packing.

DR. BOWING. I am sure that you agree that Dr. Schmitz' study deals with a very important feature of radiation therapy. In his opening statements he mentioned that urinary complications are on the increase in cases of carcinoma of the cervix uteri treated with irradiation. This does not tally with my own experience. I am sure that you are acquainted with the report of Dr. Stacy concerning complications occurring in similar cases treated on our service at the Mayo Clinic and I am pleased to report that by rearranging our treatment factors it has been grossly apparent to me that these distressing complications have been greatly reduced. The greatest number occurred during the early years and I am optimistic enough to think that they will not occur in the years to come. This feature of the treatment of carcinoma of the cervix has been very satisfactory since we have assumed the attitude that these lesions should be prevented and this in our hands has been brought about by reducing the number of hours of application, by applying more highly filtered radiation, and making certain that the distance factor employed will remain constant. This selection is best made when the patient is in the knee-chest position since the treatment field can be clearly visualized, which aids greatly in the selection of the proper treatment factors to best suit the case under consideration. I feel reasonably confident that a standard treatment time, and especially the twenty-four hour application, is most responsible for tissue changes described so well by Dr. Schmitz. I do not wish to be critical. However, I believe we should avoid the prolonged application in the treatment of carcinoma of the cervix. It is possible to obtain a satisfactory response through the divided dose method, by increasing the number of applications, and correspondingly reduce the treatment time as well as use highly filtered radiation.

DR. SCHMITZ (closing). We divide the carcinoma cases into four clinical groups, depending on the extent of the growth. Group I includes tumors not larger than 1 to 1.5 cm. In group II are placed the lesions that have involved at least one-half of the cervix. Group



III contains the advanced carcinomas and group IV the hopeless fixed carcinomas. Movability of the uterus is determined by hooking a tenaculum forceps to the cervix. If we cannot pull the cervix down to the outlet then we assume that the parametria are involved. Examination through the rectum corroborates this finding. The cases with limited mobility and parametrial involvement are placed in group III. In group II we place the carcinomas with complete fixation, or with involvement of the bladder or rectum, or both.

The reason we divide the cancers into four clinical groups is to determine the method of treatment and the relative prognosis of treatment. If the carcinoma has caused fixation it is usually hopeless. We have exceptions, but we have never seen a case of fixed carcinoma that benefited by any kind of treatment. The bleeding and offensive discharge may be arrested by a small dose of radium. Fixation may be due to infection within the pelvis which may subside following local treatment, then the proper clinical grouping and treatment may be determined. Cases in clinical groups I, II and III are treated with irradiation, though the group I carcinomas may be subjected to panhysterectomy.

It seems you have the impression that all of our cases are treated in the same way, i.e., with the same dosage. However, we individualize the treatment and the doses given are the average. I mentioned that in one case the patient had been cauterized. Thereby an unfavorable condition was brought about before the radium was applied. This was done in 1914 or 1915, when we were still not in agreement about the proper procedure of treatment. We consider the average dose to be about 3500 mg-hr. of radium in group I, II and III cases. In group IV the patient is treated palliatively with 1200 mg-el-hr. of radium. The 1200 mg-hr. we deem sufficient to arrest the bleeding and to render the field clean. If there is invasion of the bladder we use only the roentgen radiation. If regression of the bladder metastasis occurs, we then follow with radium applications to the cervix. These points are all considered in the paper.

Concerning applications of radium, the Bowing method of using twelve or fourteen hour seances repeated every third day may be a better method than the twenty-four hour

applications at eight day intervals used by us. However, we find our method very satisfactory, and the good five-year end-results prove the conclusion.

The bladder and ureter complications seen in our clinic are the result of either an idiosyncrasy of the patient or a faulty technique. Most of these cases entered the hospital on account of these complications and after having been treated somewhere else. It seems to us that reapplications of radium after a proper course of radiation therapy have caused most of the urinary tract complications. We therefore deem it poor procedure to advise repetition of radium or roentgen applications. I recently saw a patient who was in a hopeless state from carcinoma. Three years ago she was treated with 3600 mg-hr. of radium, which was probably packed in the vaginal canal. Since then the patient has had four complete seances of short wave roentgen therapy, and in addition has had three massive radium applications. She now has fistulae of the bladder and rectum, besides a frozen pelvis and retention of urine in both kidneys. The reason this paper was written was to call attention to the matter and to discuss diagnosis and treatment of such complications.

Terms operability and inoperability—I think—are poorly chosen. When surgery was the sole treatment for carcinoma of the cervix surgeons would not hesitate to operate as long as the tumor could be removed. Depending on the skill possessed, operability was extended more and more. One saw patients operated upon with extensive infiltration of the parametria. The operative mortality and complications were high. Instead of determining operability by the individual technical skill of the surgeon, it is preferable to determine operability or inoperability by such factors as normal movability, impeded movability, fixation, paracervical infiltration, parametrial infiltration, regional lymph node involvement, and so forth. Standardization of clinical grouping will mean an advance in the treatment of cancer and divide the cases into those to be treated surgically, radiologically or palliatively. Statistics based on such grouping and comparison of results of the various methods of treatment will bring us nearer the ideal than the present antiquated methods based on operability or inoperability.

The good end-results Dr. Bowing has obtained are wonderful. According to these results, arranged on the classification of Broders it appears that the clinical extent of the cancer does not influence the good end-results, but that the degree of histological malignancy or grading does. In our work in Chicago, we observed that carcinomata with a high degree of histological malignancy will show fewer five-year good end-results than those with a low-grade malignancy. If I remember correctly, Dr. Bowing reported the end-results last year on carcinoma of the rectum, and those with a low-grade malignancy showed a higher percentage of cures. Healy found that patients with a high degree of malignancy show better end-results than those with low malignancy. It would be well to restudy the entire question and determine the reason for these apparently varying reports.

DR. BOWING (closing). In reply to Dr. Stevens' question I am sure that we are all in agreement with the statement that there is a widespread misunderstanding concerning the method of classifying cases of carcinoma of the cervix uteri. Further, I am sure we will all agree that this feature is very important to a clear understanding when reporting cases. It seems clear to me that the classification should have a definite background based upon experience. It should be simple and thus readily understood by all. Probably the one most suited to our present-day needs would incorporate terms as employed in the field of surgery. The term, operable lesion, usually indicates that it is a small lesion, that it was seen early in the development of the disease, and that the pathology is confined to the primary site. Inoperable lesion usually indicates that the disease has advanced beyond the site of the primary field. In speaking of the borderline lesion we usually indicate that doubt exists as to the extent of the tumor in that it may have advanced beyond the primary site. The recurring group should comprise those cases which have been diagnosed as operable or borderline and in whom an adequate procedure was done to combat the disease. It has been my policy to have a fifth classification which has been termed the modified group. One will encounter a group of patients in whom one is reasonably certain that the condi-

tion was inoperable when first treated; and further, that a procedure was attempted which was apparently inadequate; however, the patient derived a certain amount of palliation from what was done, and in many patients, further cautious treatment may mean a return to health. So, with this in mind, these patients are deserving of our best consideration and should not be confused with any of the above groups. For the present it does not seem necessary that we hold to the classification which has been based upon a wide surgical experience. From the standpoint of prognosis I feel that our best results should come from the treatment of cases in the operable and borderline groups and that palliation may be expected in the treatment of the inoperable, recurring and modified groups. As I recall Dr. Schmitz' classification, he divides the inoperable group into those with a frozen pelvis and those without, the latter usually associated with much pain and a break in the general health. I question at this time the importance of making this distinction. From the radiological point of view, Dr. Schmitz' point is well taken; however, there is a chance of misunderstanding in trying to divide the inoperable group under two headings. This occurs to me as a purely radiological problem and probably should not enter into our classification.

Dr. Broders' classification based upon microscopic findings is important to both surgeon and radiologist and should not be confused with the above classification. The basis for his classification is many thousands of patients carefully studied by him so that he has been able to designate certain types of tumors that respond well to surgical intervention and certain types of tumors that give poor results regardless of how radical the surgery was; with this in mind, it may be confusing to some to know that Broders' groups 3 and 4 do respond readily to radiation therapy. Broders' method should be considered a distinct advance in the field of radiology. I am hoping that as time goes on more accurate information will be forthcoming from laboratories in order that more efficient treatment may be given. May I reiterate that our classification should be simple and based upon a definite background of experience known to us all.

## CARCINOMA OF THE OVARY

### REPORT OF THREE CASES TREATED BY DEEP ROENTGEN THERAPY

By A. W. JACOBS, M.D.

NEW YORK CITY

**I**N A recent study of 15 cases of carcinoma of the ovary during the ten year period from 1914 to 1923 inclusive at the Montefiore Hospital, it was noted that the average total duration of life to 1921 inclusive, with no special therapy, was twelve months; while the average duration in 1922 to 1923, when deep roentgen therapy was instituted, was twenty-three months. From this it seems that roentgen therapy is a measure to be considered in palliation of symptoms and prolongation of life.

Three cases are here reported of ovarian carcinoma which were treated by deep roentgen therapy, with palliation of symptoms, prolongation of life, and up to the time of writing were in apparent comfort and symptomless. The factors used in the therapy were 180 kv., 4 ma., 50 cm. distance, 0.5 mm. Cu and 1.0 mm. Al as filter, twenty minutes each treatment (approximately one-third erythema dose).

#### CASE REPORTS

**CASE I.** Mrs. S. Q., Jewess, aged forty-eight, was referred to me on April 10, 1929, with the following history: Married twenty-seven years, 2 children living, twenty-five and twenty-one years of age; two miscarriages twenty-six and twenty-four years ago. Menstruation started at seventeen, regular, but has been irregular for the past three years. Last period three weeks ago, painful and of nine days' duration. Had a curettage eighteen months ago for metrorrhagia. Onset of present illness was about six months ago, with cramps and sense of pressure in abdomen. Constipated, had to take cathartics. These symptoms have become more marked in the past four weeks. Has had menorrhagia for four months, periods which had been eight or nine days' duration prolonged to ten or twelve days, and increasing dysmenorrhea.

At operation by Dr. A. J. Beller at the Hospital for Joint Diseases, on March 20, 1929,

were found hard, carcinomatous masses throughout entire abdomen, involving ovaries, entire pelvis, omentum, peritoneal surfaces and liver. A piece of omentum was removed for examination and pathological report was metastatic papillary adenocarcinoma, probably primary in the ovary. Nothing to be done surgically, abdomen was closed.

On April 10, 1929, physical examination showed a well-nourished adult female, moderately dyspneic and cyanotic, complaining of a sense of pressure in abdomen, and hiccough. The positive findings were marked prominence of the abdomen and signs of fluid within the abdomen, on account of which no masses were palpable. Immediate paracentesis abdominalis was advised, to be followed by deep roentgen therapy. On April 16, 1929, 4500 c.c. of fluid was removed, 5000 c.c. on May 1, and 4500 c.c. on May 6. There was no doubt that fluid was re-accumulating rapidly. On April 29, 1929, patient was examined by Dr. William P. Healy, who concurred in the diagnosis and agreed with the therapeutic plan of procedure. Between April 10, 1929, and May 8, 1929, twelve treatments were given to the pelvis anterior, posterior, left and right lateral fields, 20×20 cm. 180 kv., 4 ma., filter 0.5 mm. Cu +1 mm. Al, twenty minutes each at intervals of two or three days.

On May 16, 1929, she was referred to the New York City Cancer Institute for further observation, then complaining of pain and swelling in the abdomen and legs and general weakness, of two months' duration. She was admitted to the hospital of the Institute on Welfare Island, orthopneic and complaining of hiccough. Physical examination revealed flatness and absent breath sounds over left base of chest and abdomen distended with signs of fluid present. On May 18, 1929, about 900 c.c. of clear fluid was removed by thoracentesis, and on May 19, 2500 c.c. was removed by paracentesis. Blood examination on May 22, showed red blood cells, 3,800,000; Hgb, 70 per cent; white blood cells, 6000, and negative Wassermann reaction.



Examination by Dr. I. Levin, director of the Cancer Institute, revealed a hard irregular mass to the left of the umbilicus, and another above the symphysis pubis and resistance in both sides with a mass posteriorly on rectal and vaginal examinations. In his opinion, the masses were too large to be influenced by radiotherapy, the case was beyond specific therapy, and needed custodial care.

Examination about five weeks later, July 3, 1929, by Dr. I. Levin showed the abdomen to be soft, small masses palpable in the right pelvic region, also palpable on vaginal examination, and uterus enlarged. Deep roentgen therapy to the pelvis, twenty minutes, once a week was advised.

Examination on October 17, 1929, revealed abdomen to be soft, no masses palpable by abdominal or vaginal examination with no evidence of fluid present.

The second series of eight treatments, which were given in the clinic, extended over the period of ten weeks between September 5, 1929 and November 21, 1929.

On December 9, 1929, which was four months after the patient was discharged from the hospital, examination showed her to be gaining in weight, appetite good, bowels regular, and absolutely symptomless. Has had no menstrual period for seven months. Physical examination showed no masses in the abdomen and no evidence of ascites.

CASE II. N. G., Jewess, single, aged twenty-eight, was referred to me on May 19, 1928, with the following history: Had measles and pertussis in childhood, influenza in 1918. Menstruation started at the age of fourteen, regular every twenty-eight days, normal, last period April 21, 1928. Operated upon in November, 1926, at Union Hospital for abdominal tumor. Since then felt fine until four months ago, when she had a painful menstrual period and upon examination of the abdomen another tumor was found. At operation April 19, 1928, at Mt. Sinai Hospital by Dr. A. J. Beller, a neoplasm of the ovary was removed, pathological report of which was adenocarcinoma. General condition of the patient was good. Deep roentgen therapy to the pelvis was instituted on May 19, 1928, anterior, posterior and lateral fields, thirty minutes each, with a total of eight treatments to June 20, 1928. Another series was given from

October 8, to November 8, 1928, twenty minutes each, and a third series between March 14, 1929, and April 11, 1929, twenty minutes each treatment. General condition of the patient during this time was good, with no symptoms or evidence of recurrence. The patient was advised to return in three months for observation of her condition but in spite of written notification failed to do so until December 2, 1929, when she returned complaining of a marked swelling over lower sternum, which had existed for six months, was increasing in size, painful and tender. General condition at this time showed some emaciation, loss in weight and anorexia. Local examination showed a hard mass arising from the lower anterior aspect of the sternum, hard in consistency and tender, apparently metastatic. Deep roentgen therapy was immediately instituted to this region, on December 2, 1929, treatments given daily, with diminution in size about one week after therapy was commenced so that examination on January 28, 1930, showed entire disappearance of the mass and general condition improved. She had gained 8 pounds in weight, and had returned to work.

CASE III. H. M., married, aged thirty-nine, was operated upon in 1919 and 1925 at St. Luke's Hospital, pathological report adenocarcinoma of the ovary, had received post-operative radiation therapy at intervals. Has had no menstrual period since operation in 1919. Under my observation since January 16, 1929, has received three series of deep roentgen therapy up to December 30, 1929. She is at present symptomless and at work in her office, though a hard mass is still palpable on abdominal examination.

*Comment.* The first case reported in this group is of unusual interest inasmuch as the malignancy was generalized throughout the abdomen with rapid re-accumulation of ascites, and in spite of the little benefit to be expected by radiation therapy, the improvement has been remarkable. The second case reported shows what can apparently be accomplished by attempts at therapy in a metastatic condition from primary carcinoma of the ovary. The third case reported shows apparent arrest of the neoplastic process by irradiation.

## CONCLUSION

It is a known fact that such results as obtained by radiation therapy in the cases reported do not and will not invariably occur in all carcinomata of the ovary. However, it is our duty to give each case a fair trial where surgical measures can accomplish nothing. It would probably be of considerable aid in prognosis if

it were made a practice to have pathological specimens removed for diagnosis, classified by a competent, experienced pathologist who can report on the degree of radiosensitivity of the neoplasm. Carcinomata of the ovary apparently are of different grades and types and should be classified by the pathologist as are those of the cervix uteri.



# THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

*Editor:* LAWRENCE REYNOLDS, M.D.

*Editorial Board:* A. C. CHRISTIE, M.D. H. K. PANCOAST, M.D. WILLIAM DUANE, PH.D.

*Advisory Board for Pathology:* JAMES EWING, M.D. EUGENE OPIE, M.D. A. S. WARTHIN, M.D.

*Collaborating Editors:* The Officers and Committee Members of the Societies of which this JOURNAL is the official organ, whose names appear on this page, are considered collaborating editors of this JOURNAL.

*Foreign Collaborators:* A. BÉCLÈRE, M.D., PARIS. GÖSTA FORSSELL, M.D., STOCKHOLM. G. F. HAENISCH, M.D., HAMBURG. R. LEDOUX-LEBARD, M.D., PARIS.

*Publisher:* CHARLES C. THOMAS, SPRINGFIELD, ILL.

*Issued Monthly. Subscription \$10.00 per year, \$11.00 in Canada and \$12.00 in foreign countries. Advertising rates submitted on application. Editorial office, 110 Professional Building, Detroit, Mich. Office of publication, 220 E. Monroe St., Springfield, Ill. Information of interest to all readers will be found on page iv.*

## Officers and Standing Committees

### THE AMERICAN ROENTGEN RAY SOCIETY

*President:* H. M. IMBODEN, New York City; *President-Elect:* A. B. MOORE, Rochester, Minn.; *1st Vice-President:* H. E. RUGGLES, San Francisco, Calif.; *2d Vice-President:* B. H. NICHOLS, Cleveland, Ohio; *Secretary:* JOHN T. MURPHY, 421 Michigan St., Toledo, Ohio; *Treasurer:* WILLIAM A. EVANS, 10 Peterboro St., Detroit, Mich.; *Librarian and Historian:* H. W. DACHTLER, Toledo, Ohio.

*Executive Council:* W. F. MANGES, Chairman, 235 S. 15th St., Philadelphia, Pa., L. R. SANTE, St. Louis, Mo., F. M. HODGES, Richmond, Va., H. M. IMBODEN, New York City, A. B. MOORE, Rochester, Minn., LAWRENCE REYNOLDS, Detroit, Mich., JOHN T. MURPHY, Toledo, Ohio, WILLIAM A. EVANS, Detroit, Mich.

*Committee on Laws and Public Policy:* B. R. KIRKLIN, Chairman, Rochester, Minn., FRED M. HODGES, Richmond, Va., WILLIAM E. CHAMBERLAIN, San Francisco, Calif.

*Committee on Safety and Standards:* P. M. HICKEY, Chairman, University Hospital, Ann Arbor, Mich., H. K. PANCOAST, Philadelphia, Pa., W. D. COOLIDGE, Schenectady, N. Y., A. U. DESJARDINS, Rochester, Minn., H. J. ULLMANN, Santa Barbara, Calif., B. H. NICHOLS, Cleveland, Ohio, G. E. RICHARDS, Toronto, Canada, R. R. NEWELL, San Francisco, Calif.

*Publication Committee:* WILLIAM A. EVANS, Chairman, Detroit, Mich., W. F. MANGES, Philadelphia, Pa., L. R. SANTE, St. Louis, Mo.

*Leonard Prize Committee:* P. M. Hickey, Chairman, Ann Arbor, Mich., W. B. BOWMAN, Los Angeles, Calif., A. C. CHRISTIE, Washington, D. C., W. A. EVANS, Detroit, Mich., G. W. GRIER, Pittsburgh, Pa., B. H. NICHOLS, Cleveland, Ohio, G. E. PFAHLER, Philadelphia, Pa.

*Tube Committee:* DAVID R. BOWEN, Chairman, Philadelphia, Pa., I. H. LOCKWOOD, Kansas City, Mo., E. C. ERNST, St. Louis, Mo., G. W. GRIER, Pittsburgh, Pa., E. A. POHLE, Madison, Wis.

*Member, National Research Council:* W. F. MANGES, Philadelphia, Pa.

*Delegate to Third International Congress, Paris, July 27-31, 1931:* P. M. HICKEY, Ann Arbor, Mich.; *Alternate,* LEOPOLD JACHES, New York City.

*Editor:* LAWRENCE REYNOLDS, 110 Professional Building, Detroit, Mich.

*Editorial Board:* A. C. CHRISTIE, H. K. PANCOAST, WM. DUANE.

*Advisory Board for Pathology:* JAMES EWING, EUGENE OPIE, ALDRED S. WARTHIN.

*Publisher:* CHARLES C. THOMAS, 220 East Monroe St., Springfield, Ill.

*Thirty-first Annual Meeting:* West Baden Springs Hotel, West Baden, Indiana, Sept. 23-26, 1930.

### THE AMERICAN RADIUM SOCIETY

*President:* H. H. BOWING, Mayo Clinic, Rochester, Minn.; *President-Elect:* H. J. ULLMANN, Santa Barbara, Calif.; *First Vice-President:* SANFORD WITHERS, Denver, Colo.; *Second Vice-President:* EDITH H. QUIMBY, New York City; *Secretary:* G. W. GRIER, Jenkins Arcade, Pittsburgh, Pa.; *Treasurer:* ZOE A. JOHNSTON, Jenkins Arcade, Pittsburgh, Pa.

*Executive Committee:* ALBERT SOILAND, Chairman, 1407 S. Hope St., Los Angeles, Calif., CURTIS F. BURNAM, Baltimore, Md., EDWIN C. ERNST, St. Louis, Mo.

*Program Committee:* H. J. ULLMANN, Chairman, 1520 Chapala St., Santa Barbara, Calif., L. R. SANTE, St. Louis, Mo., WILLIAM NEILL, Baltimore, Md.

*Publication Committee:* H. K. PANCOAST, Chairman, University Hospital, Philadelphia, Pa., HENRY SCHMITZ, Chicago, Ill., JAMES T. CASE, Chicago, Ill.

*Research and Standardization Committee:* G. FAILLA, Chairman, Memorial Hospital, New York City, H. J. ULLMANN, Santa Barbara, Calif., R. B. GREENOUGH, Boston, Mass.

*Education and Publicity Committee:* SANFORD WITHERS, Chairman, Majestic Bldg., Denver, Colo., G. E. PFAHLER, Philadelphia, Pa., D. T. QUIGLEY, Omaha, Nebr.

*Sixteenth Annual Meeting:* 1931, to be announced.

*Committee on Arrangements:* R. E. LOUCKS, Chairman, 337 W. Grand Blvd., Detroit, Mich., R. H. STEVENS, Detroit, Mich., L. B. ASHLEY, Detroit, Mich.



## EDITORIALS

### THE RADIOLOGISTS' LIABILITY INSURANCE

**I**N DELVING into the liability insurance situation it has been most interesting to find that the three companies which carry the major portion of insurance for the members of The American Roentgen Ray Society are concerned as much as we are and perhaps more, for the Society's Committee on Laws and Public Policy received from them every courtesy and cooperation. Two of them placed the records of their entire experience at the Committee's disposal, and were quite frank in revealing all pertinent information. Much interest in the subject has also been manifested by the members of the Society as evidenced by responses to the questionnaire sent out. A careful survey and compilation of the data obtained from these questionnaires and from repeated conferences with officials of the companies writing this type of insurance has revealed some very instructive facts.

Prior to a few years ago radiologists obtained insurance at the same rates as medical and surgical practitioners, but the insurance companies discovered that the risk involved was so great, especially in radiation therapy, that a marked increase in the rates was made. They are frank in admitting that it is very difficult for them to calculate the results, but they feel that they have carried this variety of insurance at a loss since 1913. In fact, the experience of the companies had been so discouraging that they considered discontinuing coverage for roentgen therapists. However, it is encouraging to find that in the last five years their experience with the members of this Society has improved greatly, and that their loss through men who limit their work to radiology is showing a marked diminution. It is surprising to

learn that a large number of suits filed or threatened are for injuries incurred in diagnostic work which are not roentgen-ray reactions but electrical shocks or burns sustained by patients or their friends coming in contact with wires or tubes during exposures.

At present, radiologists engaged solely in diagnosis are insured at the same rate as general practitioners, but an additional premium is charged if roentgen or radium therapy is employed. This rate is based on the experience of the insurance companies in the locality in which the insured is practicing. For example, the basic rate in New York State for general practitioners and roentgen diagnosticians is \$32.00 per year on a \$5000 to \$15,000 coverage, but an additional premium must be paid if roentgen or radium therapy is employed. There is an apparent lack of standardization of charges by the various companies, for discrepancies are shown in the answers to the questionnaire. As an illustration, two men in the same locality, doing the same character of work, carried the same insurance, yet paid widely different rates. In one instance of this sort both men were insured by the same company. Such inequality seems indefensible, but a variance in rates among states and localities finds justification in the differing laws of the several states, in local public opinion affecting courts and juries, and in the varying ethical morale and solidarity of physicians in different communities. Yet these are only minor phases of the problem and its essence is the general level of rates, which, in the opinion of two-thirds of the radiologists who answered the questionnaire, are too high.

In attacking this question it should frank-

ly be realized at the onset that, in the long run, rates must be adequate to cover losses plus a fair charge for administering the insurance fund. Hence the indispensable basis for a permanent reduction of rates is a reduction of liability losses, and to this latter end the radiologic profession can contribute effectively.

Electrical injuries, which are so provocative of lawsuits, can be diminished by frequent inspection, overhauling and rearrangement of apparatus or the installation of new equipment, by selecting more trustworthy technicians and imbuing them with the necessity of eternal vigilance and caution, and by active personal supervision of the work.

A potent deterrent to a threatened suit for damage is a well-kept case record, showing the date of examination or treatment, dates of previous examination or treatment elsewhere, diagnosis, details of treatment, warning to the patient regarding the application of irritants to irradiated areas, and every fact that may have any relation to subsequent reactions. A complete record may prevent litigation, or, if suit is brought may enable the radiologist to make an effective defense.

Every radiologist should willingly give testimony in malpractice suits brought against his fellows and ask to be reimbursed only for his actual expense, if he makes any charge at all. Fees of expert witnesses for the defense are charged eventually against the policy holders.

No upstanding radiologist will openly condemn the work of his fellows. He realizes that he is not acquainted with all the circumstances attending an accident or untoward reaction sustained by the patient of another physician. He knows that every stone he casts at his coworkers makes a dent in his own armor. But he sometimes fails to remember that brows lifted in surprise, faint praise, or an equivocal silence may betray a colleague and subject him to legal harassment.

Radiologists can avert damaging criticism by more intensive education of the general medical profession as to the rôle of infections, irritants and idiosyncrasies in producing reactions after irradiation, and as to the inevitable hazards of effective treatment in desperate cases of malignant disease. Members of radiologic organizations who appear on the programs of state medical societies have an excellent opportunity for service in this direction, and those who give talks over the radio can give the public much needed instruction.

Finally, in those states in which the laws are unfair and penalize the radiologist for the conscientious performance of his duty, the radiologic organizations should appeal to the legislatures for just and equitable enactments.

If by these means or others we can put our own house in satisfactory order I am confident that the insurance companies will adjust all minor inequities and give us protection at fair costs.

B. R. KIRKLIN

---

## CARL S. OAKMAN

1876-1930

ON JUNE 19, 1930, occurred the death of Dr. Carl S. Oakman at the University Hospital, Ann Arbor, Michigan. For the past four years Dr. Oakman practised roentgenology in Muncie, Indiana. Dr. Oakman was a talented violinist, having at one time been a member of the Boston Symphony Orchestra. He was secretary-treasurer of the Digestive

Ferments Co., Detroit, for thirteen years, and for three years was president and general manager of the Wilson Laboratories, Chicago. In 1924 he went to the University of Michigan as a member of the University Hospital Staff in the Department of Roentgenology, and in 1926 to Muncie. He is survived by his widow, one son, and two daughters.

---

## SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

---

*Items for this section solicited promptly after the events to which they refer.*

---

### MEETINGS OF ROENTGEN SOCIETIES\*

#### UNITED STATES OF AMERICA

##### AMERICAN ROENTGEN RAY SOCIETY

Secretary, Dr. John T. Murphy, 421 Michigan St., Toledo, Ohio.

Thirty-first annual meeting: West Baden Springs Hotel, West Baden, Indiana, Sept. 23-26, 1930.

##### AMERICAN COLLEGE OF RADIOLOGY

Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles, Calif.

Annual Meeting, 1931, to be announced.

##### SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION

Secretary, Dr. G. W. Grier, Jenkins Arcade, Pittsburgh, Pa.

Annual meeting, 1931, to be announced.

##### RADIOLOGICAL SOCIETY OF NORTH AMERICA

Secretary, Dr. I. S. Trostler, 812 Marshall Field Annex, Chicago, Ill.

Sixteenth annual session: Los Angeles, Calif., Dec. 1-5, 1930.

##### RADIOLOGICAL SECTION, LOS ANGELES COUNTY MEDICAL SOCIETY

Secretary, Dr. Orville N. Meland, 1407 S. Hope St., Los Angeles.

Meets on the third Wednesday of each month at the California Hospital.

##### RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION

Secretary, Dr. W. S. Lawrence, Medical Arts Bldg., Memphis, Tenn.

##### BUFFALO RADIOLOGICAL SOCIETY

Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St.

Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.

##### CHICAGO ROENTGEN SOCIETY

Secretary, Dr. Robert A. Arens, Michael Reese Hospital.

Meets monthly on second Thursday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

##### CLEVELAND RADIOLOGICAL SOCIETY

Secretary, Dr. Harry L. Farmer, 2930 Prospect Ave.

Meetings are held at 6 o'clock at the University Club on the fourth Monday evening of each month from September to April, inclusive.

##### DETROIT ROENTGEN RAY AND RADIUM SOCIETY

Secretary, Dr. O. J. Shore, Fisher Building, Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

##### CENTRAL ILLINOIS RADIOLOGICAL SOCIETY

Secretary, Dr. H. C. Kariher, Decatur, Illinois. Regular meetings held quarterly.

##### INDIANA ROENTGEN SOCIETY

Secretary, Dr. J. N. Collins, Indianapolis, Ind. Annual meeting each February 22 in Indianapolis.

##### MILWAUKEE ROENTGEN RAY SOCIETY

Secretary, Dr. J. E. Habbe, 221 Wisconsin Ave., Milwaukee.

Meets first Friday in October, December, February and April.

Place of meeting designated by the president.

##### MINNESOTA RADIOLOGICAL SOCIETY

Secretary, Dr. L. G. Rigler, University Hospital, Minneapolis, Minn.

Next meeting Duluth, Minn., July 14, 1930.

##### NEW ENGLAND ROENTGEN RAY SOCIETY

Secretary, Dr. Thomas R. Healy, 370 Marlboro St., Boston, Mass.

Meets monthly on third Friday, Boston Medical Library.

##### NEW YORK ROENTGEN SOCIETY

Secretary, Dr. Robert E. Pound, Fifth Avenue Hospital.

Meets monthly on third Monday, New York Academy of Medicine.

##### CENTRAL NEW YORK ROENTGEN RAY SOCIETY

Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

##### PACIFIC COAST ROENTGEN RAY SOCIETY

Secretary, Dr. Harold B. Thompson, Seattle, Wash. Two meetings a year.

##### PENNSYLVANIA RADIOLOGICAL SOCIETY

Secretary, Dr. W. E. Reiley, Clearfield, Penna. Two meetings a year, April and October.

\* Secretaries of societies not here listed are requested to send the necessary information to the Editor.



## PHILADELPHIA ROENTGEN RAY SOCIETY

Secretary Dr. John T. Farrell, Jr., 235 S. 15th St.,  
Philadelphia.

Meets monthly on first Thursday evening, Pennsylvania Hospital.

Secretary, Dr. Colin Macdonald, Lister House, 61  
Collins St., Melbourne, Australia.

Meets monthly at Melbourne during the winter.

SECTION ON RADIOLOGY, CANADIAN MEDICAL ASSOCIATION

**SOCIETA ITALIANA RADIOLOGIA MEDICA**  
Secretary, Professor M. Ponzio, University of  
Turin, Turin.

**SOCIETATEA ROMANA DE RADIOLOGIE SI  
ELECTROLOGIE**

Secretary, Dr. Nicolae Busila, 44 Elizabeta Blvd.,  
Bucarest.

Meets second Monday in every month with the ex-  
ception of July and August.

**ALL-RUSSIAN ROENTGEN RAY ASSOCIA-  
TION, LENINGRAD, USSR** in the State Insti-  
tute of Roentgenology and Radiology, 6 Roentgen  
St.

Secretaries, Drs. S. A. Reinberg and S. G. Simon-  
son.

• Meets annually.

**LENINGRAD ROENTGEN RAY SOCIETY**

Secretaries, Drs. S. G. Simonson and G. A.  
Gusterin.

Meets monthly on the first Monday at 8 o'clock in  
the State Institute of Roentgenology and Radi-  
ology, Leningrad.

**MOSCOW ROENTGEN RAY SOCIETY**

Secretaries, Drs. L. L. Holst, A. W. Ssamymgin and  
S. T. Konobejevsky.

Meets monthly on the first Monday at 8 o'clock, the  
place of meeting being selected by the Society.

**POLISH SOCIETY OF RADIOLOGY**

Secretary, Dr. A. Elektorowicz, 19 Hoza St., War-  
saw. Meets annually.

**WARSAW SECTION, POLISH SOCIETY OF  
RADIOLOGY**

Secretary, Dr. B. Krynski, 11 Zielna St.

Meets once a month except in the summertime.

**SCANDINAVIAN ROENTGEN SOCIETIES**

The Scandinavian roentgen societies have formed a  
joint association called the Northern Association  
for Medical Radiology, meeting every second year  
in the different countries belonging to the Associa-  
tion. Each of the following societies, with the ex-  
ception of the Denmark Society, meets every  
second month except in the summertime:

**SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN**

Meets in Stockholm.

**SOCIETY OF MEDICAL RADIOLOGY IN NORWAY**

Meets in Oslo.

**SOCIETY OF MEDICAL RADIOLOGY IN DENMARK**

• Secretary, Dr. O. Wissing, Copenhagen.

Meets on the second Wednesday of each month from  
October to July in Copenhagen, at 8 o'clock in the  
State Institute of Roentgenology.

**SOCIETY OF MEDICAL RADIOLOGY IN FINLAND**

Meets in Helsingfors.

**VIENNA SOCIETY OF ROENTGENOLOGY**

Secretary, Professor Holzknacht, Vienna, IX, Gen-  
eral Hospital.

Meets on the first Tuesday of each month from  
October to July.

## THIRD INTERNATIONAL CONGRESS OF RADIOLOGY

In the May, 1930, number of the Journal  
there appeared a notice in reference to the  
Third International Congress of Radiology  
which is to be held in Paris, July 27 to 31, 1931.  
Additional information has just been received  
which will be of interest to radiologists.

The registration fee is 300 francs for each  
individual member, and 50 francs additional  
for each member of the family attending the  
Congress. Application blanks will be available  
at a later date.

The five United States delegates are: James  
T. Case, Chicago, Edwin C. Ernst, St. Louis,  
Mo., P. M. Hickey, Ann Arbor, Mich., Albert  
Soiland, Los Angeles, Calif., and Douglas  
Quick, New York City.

If anyone desires more detailed information  
regarding the Congress, it may be obtained  
from either the local Secretary, Dr. R. Ledoux-  
Lebard, Paris, or the Chairman of the U. S.  
delegates, Dr. Albert Soiland, 1407 S. Hope  
St., Los Angeles, Calif.

## THE PROGRESS OF SURVEY OF RADIOLOGY

*By the American Medical Association*

The questionnaire which was prepared by  
leaders in radiology was sent out to a mailing  
list of 1,654 persons representing that specialty.  
A total of 1,150 questionnaires have been filled  
out and returned.

The Council on Medical Education and  
Hospitals, which was asked to do this work, is  
now tabulating the returns, after which it will  
publish its report, and will also prepare a  
tentative list of directors of approved radio-  
logical laboratories. The "Essentials," which  
have been prepared by representative leaders  
in the field, have accompanied each question-  
naire sent out.

All who have not sent in the questionnaire  
should do so. Additional blanks will be fur-  
nished by the Council on Medical Education  
and Hospitals of the American Medical Associa-  
tion, 535 North Dearborn Street, Chicago.

## DEPARTMENT OF TECHNIQUE

Department Editor: DAVID R. BOWEN, M.D., Pennsylvania Hospital, Philadelphia, Pa.

## THE CONSTRUCTION AND CALIBRATION OF A STANDARD DOSIMETER\*

By ROBERT B. TAFT, B.S., M.D.  
CHARLESTON, SOUTH CAROLINA

### I. CONSTRUCTION

FOLLOWING the First International Congress of Radiology, I came to the conclusion that while the Roentgen unit was probably not the final word in intensity measurement, it was undoubtedly the most satisfactory one; and that the electroscopion-toquantimeter was the most practical instrument for its measurement. However, attention is called to the fact that an instrument of this kind measures the intensity of radiation and *not* the dosage of radiation. The dosage of radiation depends not only on intensity but on wave length and other factors which are beyond the scope of this paper. Therefore, no attempt is made in this communication to correlate the Roentgen unit and the biological effect.

A survey of commercial instruments showed that while all of them had their good points, each one had some defect. Therefore, I decided to build an instrument which would be rugged and precise, which would have incorporated in it many original features, and which would be free of the defects found in others. The instrument as finally completed, after many experiments and many failures, is shown photographically in Figure 1 and diagrammatically in Figure 9.

All the materials for the construction can be bought from supply houses in this country and the total cost is not over \$25.00. All the machine work can be done in a small machine shop equipped with lathe and drill press such as is found in most

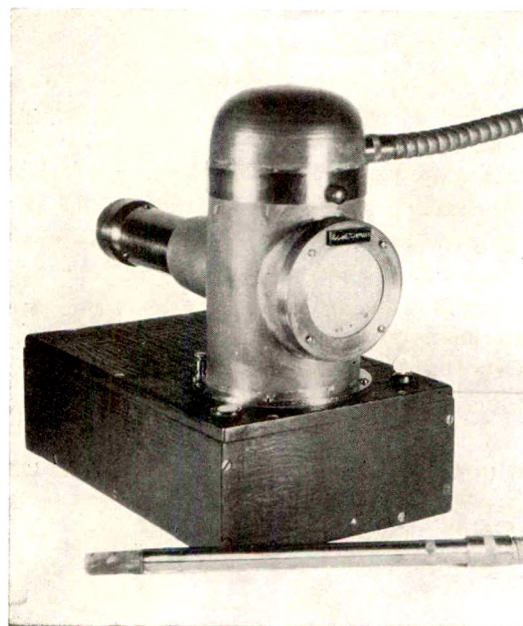


FIG. 1. The completed dosimeter, built according to the description given in the paper.

large hospitals. The work can be done by any reasonably skilled mechanic who is familiar with electrical work. The calculations are well within the reach of a physician who has a working knowledge of simple algebra.

On first consideration, it might seem that the main housing for the instrument would present much difficulty, but it can be purchased from any plumbing supply house at small cost. It is known to plumbers as a "four inch drum trap," is made of lead about  $5/64$  inch in thickness and has a cast brass cap which screws on one end.

\* Read at the Thirtieth Annual Meeting, American Roentgen Ray Society, New York City, Sept. 17-20, 1929.



Figure 2 shows the trap as purchased. A wood rod is put inside it to give supporting strength and it is placed between centers of a lathe, a dog is clamped around the square end of the brass cap and a thin cutting-off tool is used to cut off a lead cap. The cut is made about one-fourth the way along the side from the curved end. This lead cap is put away to be used later for the cover of the instrument.

The next move is to cut two holes through the sides, diametrically opposite to each other, into which are to be inserted the frosted glass window on which the shadow of the gold leaf is cast, and the tail-tube which holds the small bulb which furnishes the light. One hole is 2 in. and the other 2-3/4 in. in diameter and their centers are 3 in. from the end that holds the brass cap. The simplest way to cut these holes is to turn out a wooden form which fits snugly in the lead pipe and use a small chisel. Figure 3 shows the appearance after the above has been done.

The next step is to make the lead forms which fit over the holes. As these need circular ends, they are moulded and the outside machined off with the lathe. This is accomplished as follows: An ordinary tin can of the same outside diameter as the lead housing is procured, covered with one thickness of paper and embedded in sand

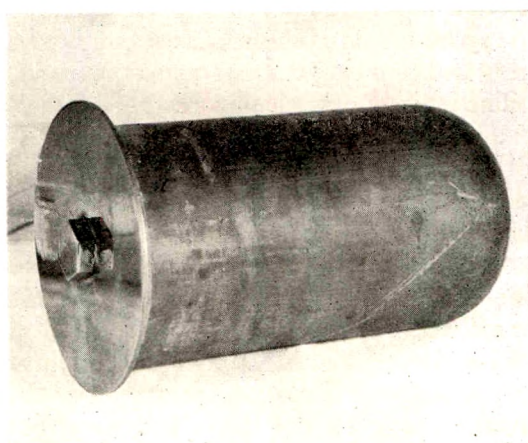


FIG. 2. The "four inch drum trap" as purchased from a plumbing supply house.

lying on its side. A mound of sand is built up on the can and a surrounding ring of sand furnishes the support for the outer portion of the melted lead. The lead is poured in and when cool it gives a rough casting, one end of which will fit perfectly up against the curvature of the lead housing. The casting is then mounted on the lathe and the outside finished off. Two castings are made, one somewhat smaller than the other as shown in Figure 1. No exact dimensions are given as simple cast-

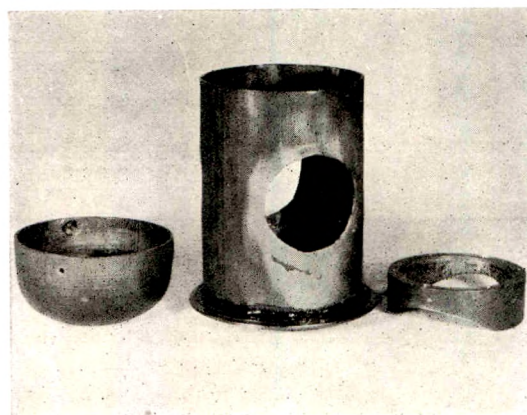


FIG. 3. The housing with cap cut off and holes cut in the sides. The finished casting for the ground glass is seen on the right.

ings of this kind made in this manner are rather crude, but they can be machined down to perfection. By referring to the illustrations, the mechanic can get the approximate size, as exact sizes are of no importance in this part of the construction.

The tail-tube is next arranged. This is a piece of ordinary 1-1/2 in. brass pipe, 5 in. long and threaded on one end. The end without the thread is inserted into the smaller lead casting which has been machined out to fit snugly.

The outer side of the larger casting is machined with a groove in the face, which accommodates the lead glass and the ground glass on which the scale is marked.

At this time the housing is ready for putting together. The castings are arranged over the holes and soldered in place with



half-and-half solder, using commercial paste as a flux. As lead is the easiest material to solder it is a simple task to do a very neat job. After the soldering is finished, all the rough edges are smoothed with a rat-tail file and later rubbed with steel wool. In a similar way, the brass pipe is soldered into the tail casting.

Next the brass cap that screws on the bottom of the housing should be heated on a stove and a thin layer of lead poured over the inside to furnish protection

lower end of which a brass plug is screwed. Then a hole is drilled through the lower part of the coupling and plug, so that a rod can be slipped in to tighten it to the main housing. The coupling should be knurled for appearance and to give a grip for the fingers when it is taken off or put on. Make sure that the plug in the coupling is air tight, and if necessary coat the inside with solder.

Next a piece of  $1/2$  in. brass tube with thin wall is inserted through the shelf and through the brass cap on the lower end of

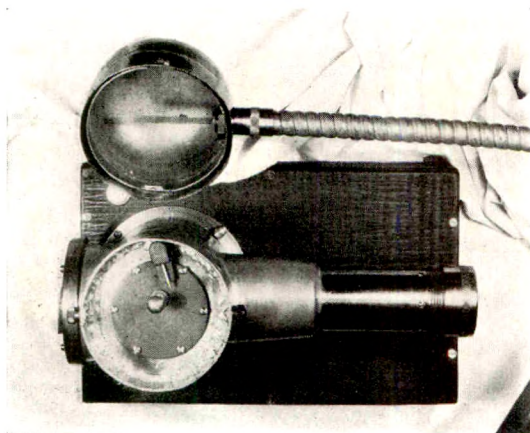


FIG. 4. A top view of the complete instrument with cap removed and turned upside down. The brass shelf is seen soldered into the housing and the leaf support is shown. Note the charging point which can be rotated to vary the distance from the ball.

against stray rays. The cap is then screwed in place and soldered to the housing.

Following this, a shelf is soldered in the upper part of the housing to support the mounting for the electroscope proper. This is shown in Figure 4, and is made of sheet brass  $1/8$  in. thick, cut into a circle fitting snugly in the upper housing and has a hole 2 in. in diameter cut in the middle. This is soldered in at a distance of  $1-1/8$  in. from the top as shown in Figure 4.

Then a small dehydration chamber to contain calcium chloride is arranged under the tail-tube as shown in Figure 5. A hole is drilled of such a size that a short nipple of a  $3/8$  in. brass pipe will fit snugly into it and the nipple is soldered in place. The chamber is made of a  $3/8$  in. brass coupling into the

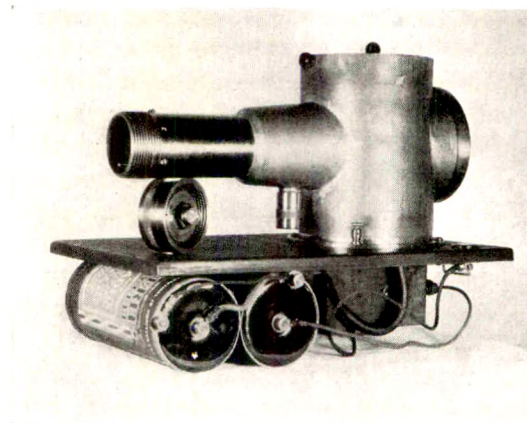


FIG. 5. The wooden base has been removed to show the batteries and spark coil. The cap on the end of the tail-tube is removed and turned around to show the light as well as the brush and brass ring which supplies the contact. Note the dehydration chamber under the tail-casting.

the housing and soldered in place as shown in Figure 4. This is used as a conduit to bring the charging current up to the leaf.

The main housing is now ready for finishing. It should be rubbed to a high polish with steel wool, both the lead and the brass parts. The brass parts should be covered with a thin coat of clear lacquer. The lead should not be lacquered as it will corrode. The entire inside of the apparatus should be painted flat black.

The glasses are next put in place. Three are needed, one disc of ordinary glass in the tail-tube, one of lead glass, for the front window and another of frosted glass upon which the scale is drawn. The lead glass and the ordinary glass are cemented in with



celluloid glue and the frosted glass is held in by the brass cap screwed on the front end as shown in Figure 1.

The lamp, which is used to cast the shadow of the leaf on the ground glass scale, is a 3 volt fine focus flashlight globe. The brass cap as seen in Figure 5 is a 1-1/2 in. pipe cap which has been dressed off and knurled. In the center of this is mounted a small porcelain wall socket, miniature size. One binding post of it is connected to the brass cap, the other is connected to a brass ring, mounted on top of a bakelite ring, serving to make contact with the brush mechanism as seen in Figure 5. The brush is bolted through a fiber ring inside the tail-tube. The wire is brought to the brush through a 1/8 in. copper tube which runs through the tail-tube and down through the bottom of the instrument. The wire itself is a piece of No. 20 BS double cotton covered shellacked.

The wooden box on which the instrument is mounted is made of some kind of well-seasoned hardwood 3/8 in. thick. The inside dimensions are 11"  $\times$  6-5/8"  $\times$  3". It is finished in dull black, and put together with brass screws with polished heads. Holes are bored in the cover of the box to line up with the holes in the bottom of the instrument through which the wires pass to the charging point and the lamp. The instrument is bolted to the box. A binding post is fastened to the housing at some convenient point to be used for ground connection.

The charging device has already been described in detail<sup>5,7</sup>, and two standard dry cells are used to furnish power for the charging coil and lamp. A small switch is mounted on one corner of the base to act as a lamp turnoff, and a push button is placed on the other corner connected in the primary circuit of the spark coil. The lamp switch also acts as a main switch and prevents the possibility of charging when the lamp is not lighted. The method of mounting the needle point is shown in Figure 4.

The lead cap which was cut off the top of the drum trap is now worked on. As can be

seen in Figure 1, a brass petticoat is soldered on the outside and slots are provided for fastening it to the housing with thumb-screws. A lead petticoat is also placed in the inside as shown in Figure 4. A hole is drilled in one side to accommodate the cable terminal and a brass escutcheon soldered around it. Note that the cap fits on the housing in such a way that the cable may be arranged either to the right or left of the operator to suit the convenience of his particular layout of apparatus.

The housing now being complete, the mount for the leaf is arranged. A disc of 3/16 in. hard rubber is cut and six holes drilled near the outer edge to bolt it to the shelf as shown in Figure 4. Corresponding holes are drilled in the shelf and threaded for a fine screw. Then a 3/8 in. hole is drilled about 3/8 in. from the center of the hard rubber disc. The actual leaf support is made as shown in Figure 6, an amber bushing being pressed into the 3/8 in. hole and fastened with celluloid cement. It is to

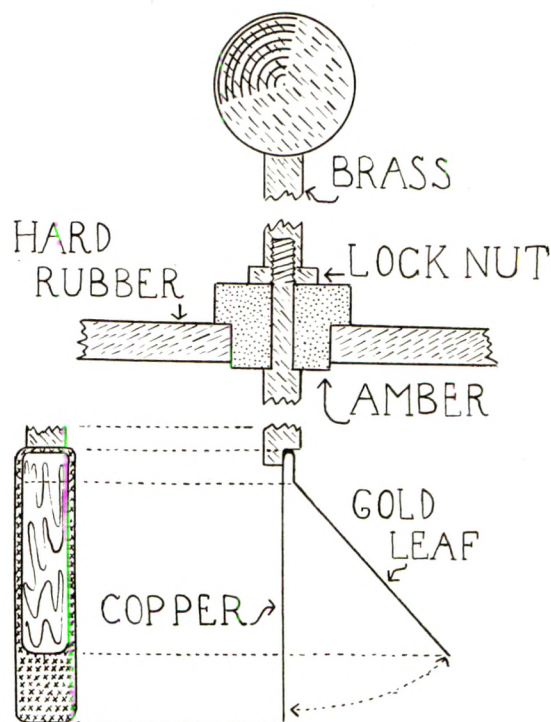


FIG. 6. Detailed drawing of the leaf and its mounting.



be noted that the leaf is mounted so that, when charged, it extends in the opposite direction from the conduit which brings up the high-tension wire. That is, if the conduit is on the left of the instrument, the leaf should swing to the right.

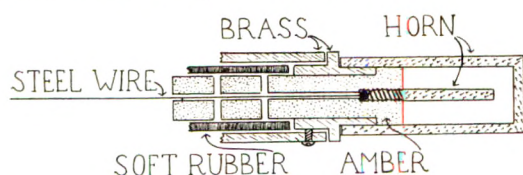


FIG. 7. Drawing of the ionization chamber and its attachment to the cable. Note that the steel wire has a small head soldered on it. The horn rod screws into the amber without any bushing and makes contact with the head on the wire.

Pure amber rods of 12 mm. diameter can be purchased from importing houses, but one must make very sure that the material is amber and not celluloid or bakelite as these two are absolutely worthless for insulation of this kind.

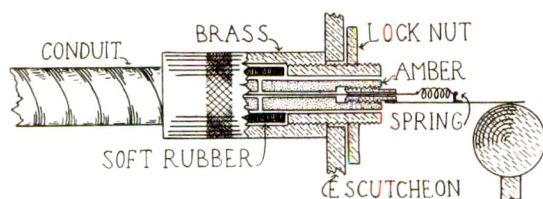


FIG. 8. Drawing of the end of the cable which enters the lead cap on top of the main housing. Note the coil spring which allows a slight motion of the steel wire when the cable is bent. The spring strip presses lightly on the ball on the head of the leaf support.

The leaf is made of gold and can be obtained from any sign-painting establishment. Aluminum leaf may also be used but I have had no experience with it. The leaf is  $1/4" \times 1-1/4"$ , but the exact size is of no moment. This is cut by placing it between two sheets of paper, and cutting paper and leaf with a very sharp pair of scissors (preferably new ones). Any kind of glue is used for fastening the leaf to the mount. Numerous trials will be necessary before a perfect leaf is put in place, but when it is finally placed, it will last for years. Details

of the leaf mount are shown in the drawing (Fig. 6).

After the leaf is mounted some calcium chloride is put in the dehydration chamber and allowed to stay for several days. In dry, cold weather, the leaf should hold its charge for several hours, and if it does not, either the amber is of poor grade, or has

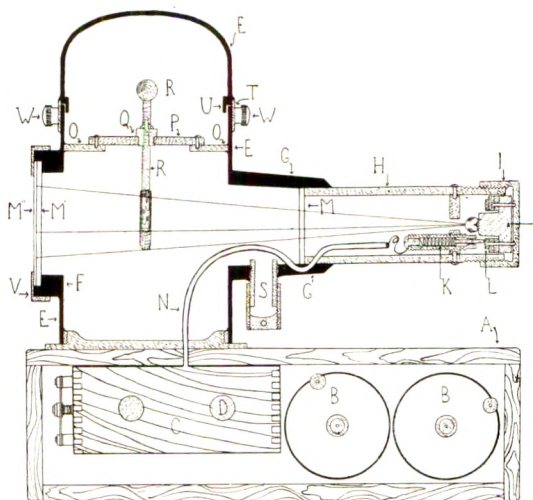


FIG. 9. A. Hardwood box. B. Standard dry cells. C. Ford spark coil. D. Positive high tension terminal. E. Lead casing. F. Casting for front window. G. Casting for tail-tube. H. Brass tail-tube. I. Brass cap. J. Porcelain socket. K. Brush mechanism. L. Commutator. M. Plain glass. M'. Lead glass. M''. Frosted glass. N. Copper tube carrying wire to lamp. O. Brass shelf. P. Hard rubber disc. Q. Amber bushing. R. Leaf mount. S. Dehydration chamber. T. Brass petticoat. U. Lead petticoat. V. Brass rim for window. W. Thumbscrews for holding cap.

some foreign material on the surface, such as perspiration from handling.

After a satisfactory leaf is put in place and the charge remains for a satisfactory time, a small ink dot is put on the glass in the tail-tube and its shadow marked on the ground glass, so that when the bulb has to be replaced, the knurled cap on the tail-tube can be rotated until the marks again line up. In this way the error of parallax is avoided.

The attention is now turned to the ionization chamber and cable. (See Fig. 7.)

The chamber is turned out on the lathe from a piece of well-dried horn of a long-horned steer. About 2 in. from the tip is a portion that has no central cavity. The exact size is of no importance but the volume should be about 2 c.c. If the inner end is squared off, the measurement of the volume can later be made with greater accuracy. The rod inside the chamber is also of horn. The rod and inside of chamber are coated with India ink.

The cable is made of flexible conduit about 1/2 in. inside diameter and can be obtained from any electrical supply house. The inside should be carefully cleaned out by pulling pieces of cloth on a wire through the lumen. The terminals are couplings of 3/8 in. brass pipe with the threads bored out on one end, polished and knurled. The conduit is soldered into the end of the terminal from which the threads have been cut. Then a section of 3/8 in. brass pipe, 9 in. long with one end threaded, is screwed into the open end of one of the couplings. A piece of thick-walled soft rubber tubing is pulled through the conduit and the ends cut off even, all of the talcum having been carefully removed from inside and outside the tube. It is this rubber tube that absolutely prevents any ionization in the cable when stray radiation strikes it.

Next the process of making the amber beads that fill the tube is commenced. They are made of amber rod, 8 mm. diameter, cut into sections about 10 mm. long. It is unnecessary to round the ends. These sections are set up, one by one, in a scroll chuck of the lathe and a 1/16 in. hole drilled through the center of each. Length of the cable is made to suit the layout of the user but a cable 5 ft. in length is usually adequate. The conducting wire is a piece of fine steel piano wire. This is run through the beads and the entire string pulled through the rubber tube in the cable. The assembling should be done in cold, dry weather.

The details of the two terminals for the conduit are given in Figures 7 and 8. The

bushings are made of amber rods 12 mm in diameter. Attention is called to the spring on the end of the steel wire which takes up the slack (Fig. 8).

A phosphor-bronze spring strip makes contact with the ball on the head of the leaf support. After the construction, the entire system is tested for leak. In dry weather the leaf should take several days to fall over the scale if there is no radiation in the region of the instrument.

In all the structural details, no effort has been made to give exact dimensions or directions as each builder will make some modifications in accordance with the materials on hand.

#### CONCLUSIONS

A dosimeter is described which has the following features:

*Ruggedness.* This instrument was carried in an automobile over rough streets without injury to the leaf.

The leak is negligible ranging from five days in dry weather to two days in very humid weather. There is no electrical saturation effect in the cable, that is, the leaf is just as stable the instant after it is charged as it is several days later.

*Protection.* The soft rubber tube in the cable prevents all ionization in it. The most powerful ray can be directed on it and there is no fall of the gold leaf except when the ionization chamber is irradiated. The main housing is of lead which prevents the entrance of any stray radiation.

*Upkeep.* This instrument has been in steady use for over two years and there has been no replacement of the leaf, one replacement of light, and two replacements of batteries. A radium check was made on November 13, 1926, with 50 mg. element and a careful drawing made of the position of the capsule on the chamber. The average time of the fall of the gold leaf for five trials was 193 seconds. Repeated December 21, 1928, the fall was 194.9 seconds. As it is impossible to reproduce the exact placing of the radium, this indicates excellent stability.

## II. CALIBRATION

In the following explanation, I shall describe methods of calibration based entirely on electrical and mechanical factors of the instrument.

For the sake of completeness the definition of the unit used is quoted from the report of the Second International Congress of Radiology: "That this International Unit be the quantity of X-radiation which, when the secondary electrons are fully utilized and the wall effect of the chamber avoided, produces in one cubic centimeter of atmospheric air at 0 degrees C. and 76 cm. mercury pressure, such a degree of conductivity that one electrostatic unit of charge is measured at saturation current." "That the International Unit of X-radiation be called 'The Roentgen' and that it shall be designated by the small letter 'r'."<sup>4</sup>

The author wishes to call attention to the fact that the units of measurement of potential and capacity are the "absolute units" of the Centimeter-Gram-Second system and *not* the volt and the microfarad. Failure to take note of this has led to many misunderstandings. The relationship is given as follows:

Electrostatic potential to volts, multiply by 300.<sup>1</sup>

The centimeter of capacity (c-g-s unit) is 1.1124 micromicrofarads.<sup>3</sup>

This formula is generally accepted as the proper relationship of the factors:<sup>2</sup>

$$\text{The number of Roentgen units transmitted} \dots = \frac{C (V_1 - V_2)}{300V}$$

Where

C = capacity of system in centimeters.

V<sub>1</sub> = voltage of system at start.

V<sub>2</sub> = voltage of system at finish.

v = volume of chamber in c.c.

It therefore becomes a problem of determining the factors of this particular instrument and supplying them in the above formula to determine the number of r-units which the roentgen machine applies to the ionization chamber while the

leaf falls over the predetermined part of the scale.

The first consideration is the volume of the ionization chamber whose walls are made of horn, having a low atomic weight. The easiest and most accurate way is to make a roentgenogram of the chamber on a dental film, with the tube at a long distance and exactly centered over the center of the chamber. On the film, the area of the air space is measured with dividers and the volume calculated. Next the volume of the inner rod is determined, similarly, and its volume subtracted from that of the chamber. My instrument has a volume of 2.768 c.c.

Next the voltages of the system at the starting and finishing points of the leaf are determined. For this a source of direct current of about 550 volts potential, a potentiometer, and an accurate voltmeter are needed. The finishing voltage should not be much below 200 V as approximately that potential is necessary for saturation. Through the kindness of the local power company, I was able to carry my instrument to the meter shop where such a source of power and suitable meters were available. The scale was marked at 545 V and 195 V. As can be seen in the formula, the 300 in the denominator converts the volts into the electrostatic units of potential.

The only remaining step is to determine the electrostatic capacity of the system in centimeters. For this a standard condenser of known capacity is needed. Rather than attempt to use any laboratory instruments I constructed a simple two-plate condenser of cast brass with amber spacers. The plates were circular and of about 15 cm. diameter and the separation was about 0.5 cm. This was sent to the U. S. Bureau of Standards for determination of capacity. It was reported as 37.0 micromicrofarads which is equal to 33.26 cm. The capacity of the system was then compared with that of the standard by means of my original method,<sup>6</sup> which is summarized as follows:



Place a small amount of radium element on the ionization chamber, screening it well with lead from the rest of the system. Time the fall over any convenient part of the scale. Then connect the standard condenser in parallel with the system and again time the fall over the same scale. Of course, if there is an error caused by leak in the standard condenser, it must be corrected for in the usual manner. As the time of fall is directly proportional to the capacity under similar conditions, we derive the proportion:

$$\frac{C}{C+S} = \frac{T}{I}$$

Where

C = capacity of system.

S = capacity of standard.

T = number of seconds of fall without standard.

I = number of seconds of fall with standard.

When simplified this gives:

$$C = \frac{ST}{I-T}$$

The capacity of the system was thus found to be 43.9 cm.

This completed the determination of the individual factors and they are inserted into the formula thus:

$$r = \frac{43.9(545-195)}{300(2.768)}$$

$$r = \frac{15365}{830.4}$$

$$r = 18.53$$

The above calculation shows that when the leaf travels from the starting point on the scale to the finishing point, 18.53 Roentgen units have been delivered to the ionization chamber. If the time of the travel is measured with a stop-watch, it is a simple matter to determine in what length of time a given number of units will be delivered. As the natural leak of this instrument is insignificant, no calculation has to be made for it on average tests.

The instrument may be used as described to determine the total dose, or it may be used in a phantom to determine depth curves. It may also be used as a simple, uncalibrated electroscope for radium comparisons by removing the lead cap and the cable.

#### SUMMARY

A complete description has been given of the structural form of a satisfactory electroscope-iontoquantimeter which has embodied in it several original features.

A complete description has been given of the method of calculating the r constant of this instrument by purely mechanical and electrical measurements.

ADDENDUM: As soon as it was announced by the U. S. Bureau of Standards that they were ready to calibrate instruments for individuals, the author took his to Washington. Comparisons were made with the Bureau of Standards instrument at several different voltages and filtrations.

At 132 kv. which was the highest voltage then available, filtered through 0.5 mm. copper, my instrument showed the full scale to be equal to 20.2 r. At 125 kv. and 4 mm. aluminum the scale showed 22.2 r. It will be noted that these figures are very close to those which I had calculated as being the values for this instrument and it is reasonable to suppose that at 200 kv. and 0.5 mm. copper the true reading would be even closer.

These figures prove that it is quite practicable to calculate these values as described in this paper provided the instrument is to be used for fairly hard radiation. However a check against a standard instrument is always advisable if such can be made.

The original gold leaf which was put in this instrument over three years ago was not damaged by the trip to Washington, was carried on to New York, and on returning to Charleston, is still in perfect shape.

## REFERENCES

1. FOSTER. Electrical Engineers Pocketbook. Seventh edition, p. 9.
2. HIRSCH, I. SETH. Principles and Practice of Roentgen Therapy. American X-Ray Publishing Co., 1925, p. 173.
3. Radio Instruments and Measurements. Circular No. 74. U. S. Bureau of Standards. Second edition, p. 235.
4. Report of International X-Ray Unit Committee. *Radiology*, 1929, 11, 510.
5. TAFT, R. B. Charging device for electroscope. *Radiology*, 1926, 7, 513-514.
6. TAFT, R. B. A simple method for the determination of the electrostatic capacity of the electroscope. *Radiology*, 1928, 10, 257-258.
7. TAFT, R. B. Further modifications of electroscopic charging device. *Radiology*, 1929, 12, 65.

## DISCUSSION

DR. R. R. NEWELL, San Francisco, Calif. A small ionization chamber like the one Dr. Taft has just shown us has many advantages, but it has the disadvantage that it doesn't agree with the international definition of "r" because the chamber has a "wall." This wall is exposed to the roentgen rays, and the scattered rays and secondary electrons from the wall have their effect on air within the chamber.

Such a small chamber may be calibrated by comparing it with a chamber in which the roentgen ray acts on an effectively isolated cubic centimeter of air, not in contact with anything but air. Such a comparison of the small chamber with the large "all air" or "air wall" chamber demonstrates the fact that measurements with the small chamber do not strictly parallel those with the "all air standard" when the quality of the radiation is changed.

But Glasser and others have shown that the small chamber can be made to agree fairly closely with the international standard throughout the range of useful therapeutic wave lengths if the chamber is made of proper materials. Glasser obtained an extremely close correspondence by impregnating the carbon walls of his chamber with the salts of magnesium and aluminum. We have obtained a correspondence within 10 per cent for wave lengths effective 0.17 Å to 0.45 Å by making the wall of a 1 c.c. chamber of very thin Japanese lens paper coated with a very thin layer of graphite in glue, and using a central electrode of aluminum of carefully selected size. The surface of aluminum exposed gives the proper correction in one direction for the error produced by the carbon wall in the other direction.

DR. G. FAILLA, New York City. I think Dr. Taft has constructed a simple instrument of the electroscope type which is well adapted for

certain practical measurements. However, the use of such an instrument as a standard for the *direct* determination of roentgen-ray amounts in r-units is hardly to be recommended.

Dr. Newell has mentioned the difficulties due to the influence of the walls and electrode of the chamber when the quality of the radiation is varied. In addition, the method of direct calibration of this instrument when used as a standard is not so simple as it might appear from the description. Accordingly I would say that it is preferable to calibrate a device of this type by comparison with a large air chamber and then use it for practical measurements in the radiological clinic.

The charging device used by Dr. Taft is certainly very simple and should prove satisfactory. The cable joining the ionization chamber to the electroscope proper is very good. I believe Dr. Weatherwax was the first one to make a cable of this type with amber beads, about nine years ago. We have had very good success with similar cables.

Dr. Taft (closing). I know that certain errors are encountered in the use of small ionization chambers. I am perfectly familiar with things that have been done along that line.

I did not bring this up with the idea of suggesting that it be used as a micro-instrument with which we can measure dosage absolutely. I found it very handy for measuring phantom doses and I think it is very satisfactory for measuring day-to-day doses. I realize full well that this instrument has not the accuracy of the large ionization chamber, but we have to realize that when we measure ionization with the large chamber we are not getting back-scattering from the patient. I believe you will meet with more success if you measure doses with small chambers on patients.



## INDEX TO ABSTRACTS



## ROENTGEN DIAGNOSIS

*Neck and Chest*

- BÁRSONY, TH.: Calcium shadows in the region of the soft tissues of the neck..... 83
- DOUB, HOWARD P.: Roentgen diagnosis and treatment of thymomata..... 83
- ARONS, ISIDORE: Sarcoma of the thyroid gland..... 83
- CHAUMET, G.: Complementary researches on pulmonary tuberculosis of adults..... 84
- ASSMANN, H.: Infraclavicular foci of infiltration as evidence of incipient tuberculosis of the lungs in young adults..... 84
- MATHES, MARY E., REICHERT, F. L., AND HOLMAN, EMILE: An experimental method for the radiographic demonstration of the bronchial and pulmonary arteries..... 84
- PRIESEL, RICHARD: The roentgen appearance of the azygos lobe..... 85
- SINGER, S.: On the differential roentgen diagnosis of intrathoracic diseases..... 85
- POPOVIĆ, LAZA: Studies on bronchography... 85
- BORDET, EMILE: Variations of the cardio-aortic shadow due to obesity or emaciation..... 85
- GAUDIN, CHARLES: Orthodiagrammeter for radiosopic examinations of the heart.... 86
- STUMPF, PLEIKART: Isography and cinematography of the heart..... 86
- RITVO, MAX: Hernia of the stomach through the esophageal orifice of the diaphragm.. 86

*Abdomen*

- DIACLÈS: Compressor and selective apparatus for the relief study of the digestive tract. 87
- BERG, HANS H.: Relief studies of the gastrointestinal canal..... 87
- DARBOIS, HUET, J.-A., AND SOBEL: The roentgen diagnosis of gastric syphilis..... 87
- BROC, RENÈ, AND JAUBERT DE BEAUJEU, A.: Congenital biloculation of the stomach with an intrathoracic pocket or hernia of the diaphragmatic hiatus..... 87
- DWYER, MAURICE F., AND BLACKFORD, JOHN M.: Interpretation of gastric symptoms. 87
- FANARDSHEW, BARTHOLOMÄUS: The diagnosis of niches in duodenal ulcer..... 88
- VORHAUS, MARTIN G.: Recognition of some of the less common diseases; duodenal-jejunal diverticula; mucocoele of the appendix and the cecum..... 88
- FRIEDENWALD, JULIUS, MORRISON, THEODORE H., AND FELDMAN, MAURICE: Chronic duodenal stasis observations in twenty-four cases..... 88
- BARGEN, J. ARNOLD, COPELAND, MURRAY M., AND RANKIN, FRED W.: Tuberculosis of

- the sigmoid colon simulating a primary malignant lesion..... 89
- GINZBURG, LEON, AND BENJAMIN, EMANUEL W.: Lipiodol studies of post-operative biliary fistulae..... 90
- BENHAMOU, ED., AND MARCHIONI, R.: Roentgenoscopy and roentgenography of the spleen..... 91
- Gynecology and Obstetrics*
- Lynch, FRANK W.: Uterine fibromyoma.... 91
- Skeletal System*
- KIENBÖCK, ROBERT: On severe chronic infantile polyarthritis and its sequelae—general arrest of development and micromelia "pseudo-achondroplasia"..... 92
- JAULIN, AND LIMOUZI: Bilateral congenital subluxation of the head of the radius.... 92
- MICHAJLOW, MICH., AND TSCHEREPNINA, M.: The cartilaginous islands of the vertebrae and their roentgen appearance..... 92
- SANTOS, JOSÉ V.: Giant cell tumor of the spine 92
- SGALITZER, MAX: Roentgen study for the demonstration of tuberculosis of the vertebrae in an early stage..... 93
- RUTH, C. E., AND RUTH V. A.: Fractures of the hip..... 94
- MEYER, M., AND SICHEL, D.: Roentgen study of a case of osseous mycosis (mycetoma or paramycetoma)..... 94
- SUTHERLAND, CHARLES G.: Roentgenographic characteristics of lesions of bone..... 94
- KOPYLOW, M. B., AND RUNOWA, M. F.: A contribution of the knowledge of marble bones..... 95
- PAISSEAU, LAQUERRIÈRE AND SCHÉRER: Roentgenograms of a somewhat peculiar case of sclerodermia..... 95
- FUSARI, A.: Tuberculosis of the acromioclavicular joint..... 95
- CODET AND KAUFFMANN: A case of osteochondromatosis of the elbow..... 96
- ALQUIER, A.: Multiple enchondromas of both hands..... 96
- WEIL, S.: Unusual form of multiple developmental disturbance of the fingers in adolescence..... 96
- SCHRADER, ERWIN: Three-jointed thumbs... 96
- PIFFAULT AND BARREAU: Roentgenograms of the hands. Lesions of the terminal phalanges..... 96
- BELOT, KIMPEL AND NEBOUT: A rare case of ectrodactylia..... 96
- HALJERMANN, W.: On the knowledge of osteitis deformans Paget of the spinal column 96



- LYON, ERNST: The appearance of the intervertebral discs in typhoid spondylitis.... 97
- SCHMORL, GEORG: Cartilaginous nodes on the posterior surface of the intervertebral discs..... 97
- PIFFAULT AND BARREAU: Roentgenograms of the spine..... 97
- DELHERM AND MOREL-KAHN: Concerning ivory vertebrae..... 98
- GALLAND, MARCEL, AND DE LAS CASAS, HERMAN: Lumbosacral dynamics. A practical study of the technical and clinical radiology (lumbosacral Pott's disease)..... 98
- LAMY AND LEPENNETIER: Post-traumatic vertebral malformation giving the appearance of osteomalacia. Vertebral osteopoeilia? 99
- KREUZ, LOTHAR: Unusual alterations of the epiphyses of the femoral heads in a child. 99
- NICHITA, M. I.: Diagnosis and early treatment of congenital dislocation of the hip. 100
- SAUER, WALTER: The pathogenesis of Köhler's disease of the os naviculare tarsi..... 100
- Blood and Lymph System*
- GRIFFITH, J. P. CROZER: Mikulicz's disease and the Mikulicz syndrome..... 100
- General*
- EVANS, NEWTON, AND BALL, HOWARD A.: Coccidioidal granuloma..... 101
- ROENTGEN AND RADIUM THERAPY**
- KUHLMANN, B.: The prognosis of lymphogranulomatosis..... 101
- ASTI, LUIGI MARIO: Technique of construction of apparatus of Columbia paste for superficial radium therapy..... 101
- HOPWOOD, F. L.: The Radium Department of St. Bartholomew's Hospital, London.. 102
- WALTER, E.: Radiotherapeutic treatment in a case of partial calcification of the articular capsule of the shoulder..... 102
- ROTH, M., AND STEINER, E.: Radiotherapy of acute inflammatory infections..... 102
- BRUNER, EDWARD: Concerning the treatment of skin diseases with Bucky borderline rays..... 103
- BRAUER, A.: On standardization of roentgen procedures in dermatology..... 103
- HOFFMAN, J. M.: Radium in the treatment of diseases with subcutaneous or mucous membrane hemorrhages..... 103
- REMER, JOHN, AND BELDEN, WEBSTER, W.: X-ray diagnosis and therapy of thyroid disease..... 103
- HOLZKNECHT, G.: The roentgen treatment of morbus basedowii..... 103
- SOILAND, ALBERT: The present status of roentgen ray therapy in breast malignancy. 104
- EVANS, WILLIAM A., AND LEUCUTIA, T.: The roentgen-ray treatment of intrathoracic tumors..... 104
- LANGERON, L., AND DESPLATS, R.: Radiotherapy of the region of the suprarenals; vasomotoric medication..... 105
- GAUDUCHEAU, R.: Curie therapy in inoperable cancers of the rectum with the method of Neumann and Coryn..... 106
- DEL BUONO, P.: Pathogenesis and roentgen treatment of essential metrorrhagia in young subjects..... 106
- MISCELLANEOUS**
- LACASSAGNE, A.: The importance of filtration and superiority of pure gamma radiation in the radiotherapy of malignant tumors. 106
- COHN, MAX: The stereoscopic visualization of the skin in roentgenograms..... 107
- STEPHANI, JACQUES: The use of the Bucky diaphragm in pulmonary roentgenograms 107
- BRAMS, JULIUS, AND DARNBACHER, LEO: The effect of x-rays on the gall-bladder; experimental production of an x-ray cholecystitis 107
- CASATI, A.: "Zones of action" in irradiated bodies..... 107
- CANTI, R. G.: Biological effects of radium irradiation..... 108
- BODE, H.-G., AND RIECKE, E.: On the histology of sensitized roentgen irradiated skin..... 108
- HENRARD, E.: Electrical shock at 110 kv., laboratory accident..... 108
- PFALZ, G. J.: The immuno-biologic effect of mild roentgen irradiations on the bactericidal power of the blood..... 109
- GLOCKER, R., AND REUSS, A.: Measurements in radiation protection..... 109
- GUNSETT, A.: The evaluation of the cutaneous reactions in r (electrostatic) units and in R (Solomon) units, with some remarks on the dependence on the wave length of the number of r leading to the same cutaneous reaction..... 110
- GUEBEN, GEORGES: Concerning the technique of measurement of penetrating radiations 110
- STRAUSS, SIEGMUND: Borderline-ray mecapion and further improvements in the roentgen mecapion..... 111
- KÜSTNER, HANS: The role of the large and small ionization chamber in roentgen measurements..... 111
- CHANTRAINE, H., AND PROFITLICH, P.: Artificial radium rays?..... 111
- DAUVILLIER, A.: The application of the principles of television in roentgenology; the "radiophot"..... 111
- BRAUN, R., AND KÜSTNER, H.: The physics of the small thimble ionization chamber. III. The accuracy of the absolute determination of the roentgen unit with the thimble chamber and large air chamber..... 112

## ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

### ROENTGEN DIAGNOSIS

#### NECK AND CHEST

BÁRSONY, TH. Kalkschatten im Bereiche der Nacken-Weichteile. (Calcium shadows in the region of the soft tissues of the neck.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Nov., 1929, 40, 809-812.

By taking roentgenograms of the neck in true lateral position calcareous deposits were found in the soft tissues opposite the spinous processes of the lower cervical vertebrae. These calcifications may account for the pain in the neck of many patients examined.—*T. Leucutia*.

DOUB, HOWARD P. Roentgen diagnosis and treatment of thymomata. *Radiology*, March, 1930, 14, 267-281.

In the view of the author, too large a percentage of primary tumors of the thymus have passed unrecognized before autopsy. While the cases are uncommon they are not so rare as has been thought. The sarcomatous type of tumor predominates but a carcinomatous type of tumor also occurs. Roentgen examination of the chest will reveal the tumor as a more or less circular, sharply defined, non-pulsating mass occupying the anterior mediastinum. Roentgen therapy is indicated as soon as the diagnosis is made; the tumors are quite sensitive to radiation therapy and their prompt regression can usually be expected.—*J. D. Camp*.

ARONS, ISIDORE. Sarcoma of the thyroid gland\* *Ann. Surg.*, Jan., 1930, 91, 44-56.

Malignant disease of the thyroid gland is admittedly infrequent. Of this small group, the epithelial tumors predominate over those of mesoblastic origin. The thyroid anlage is an ectodermal derivative, which shares, with the remainder of the alimentary tract and its allied organs, a rare disposition to sarcomatous development. The gross anatomic appearance, the age of incidence, and the clinical course of thyroid carcinoma and sarcoma are so similar that it is almost a clinical impossibility to differentiate preoperatively between them.

In regard to incidence, the ratio of carcinoma to sarcoma is variously given as 10 to 1, or even 4 to 1. The greatest incidence of thyroid malignancy occurs in those particular geographic areas where endemic goiter is prevalent. Other frequently mentioned etiologic factors are trauma and previous inflammation of the gland. Balfour has seen several cases of malignancy which developed subsequent to the injection of various irritants into large thyroids. Most sarcomas occur in the fifth and sixth decades of life. Arons found the average age to be fifty-three years.

The difficulty in diagnosis persists until the capsule of the gland is perforated by the growth. The rate of growth and approach of death are much more rapid in sarcoma than in carcinoma, but this is a weak criterion for differential clinical diagnosis. Other conditions to be differentiated are benign adenoma, tuberculosis and sudden hemorrhage into a cystic cavity in a thyroid. The occurrence of branchiogenic cysts and cysts of the cervical sinus along the anterior border of the sternomastoid muscle and the similar location of aberrant thyroid malignancies should also be remembered.

Classification of sarcomas of the thyroid: (1) Spindle cell sarcoma, of which the fibrosarcoma is a desmoplastic type. This is the most common variety of sarcoma of the thyroid gland. (2) Round cell sarcoma, including a type that resembles the malignant lymphocytoma. (3) Mixed cell sarcoma, of which the so-called giant cell sarcoma is a subgroup. (4) Carcino-sarcoma. (Epitheliosarcomas.)

Metastases occur chiefly to lungs, liver, bone, kidneys and gastrointestinal tract.

Radiation treatment of thyroid sarcoma. Perthes believes that sarcoma of the thyroid is as favorable for radiation therapy as sarcoma of the lymph nodes or tonsil. Schädel, on the contrary, believes that sarcoma of the thyroid does not react well to irradiation. The radiosensitivity of thyroid neoplasms increases in the following order of ascendancy: fibrosarcoma, carcinoma, mixed cell sarcoma, round cell sarcoma. The relative radioresistance of fibrosarcoma is due to its fibrous

character. For this reason radium is preferred to roentgen therapy, because the former exerts a strong action directly on the tumor cells, whereas the latter injures indirectly to some extent by vascular and connective tissue changes. Moreover, if the growth is well localized in the thyroid, radium is preferable to the roentgen ray because the latter tends to injure the remaining normal thyroid tissue. Parathyroid tetany has followed heavy general-ized irradiation of the thyroid region.

The metastases in the later stages of the disease are not controlled well by irradiation. For such cases roentgen therapy is a more suitable palliative measure. Irradiation for thyroid sarcomas may be (a) postoperative (prophylactic); (b) preoperative; (c) complete treatment for inoperable cases (palliative).

Interstitial radium therapy can be applied in several ways. A postoperative drainage tube inserted in the wound bed may contain radium capsules in tandem to give about 650 millicurie-hours (Bowing). After surgical exposure of the tumor mass, steel needles containing radium salt or emanation may be placed in parallel arrangement throughout the lesion. The filter in such a case is the equivalent of 0.5 mm. silver. Radon implants in the form of gold or platinum "seeds" with filtration of 0.3 mm., can be inserted into the tumor by means of hollow needles and stylet. External irradiation by means of a radium pack or moulage applicator can be given to the limit of skin tolerance. In postoperative cases such treatment should be withheld until the incision is healed.

The usual expectancy of life is two or three years after the inception of the disease. The disease is almost invariably fatal. The cures reported for sarcoma of the thyroid occurred in those instances where the discovery of sarcoma was made by pathological examination after an operation for presumably benign goiter. This really represents malignancy in a preclinical stage and naturally is the only type which affords a prospect of cure. Of the 17 cases recorded by Arons, radium and roentgen rays were used in several cases and seemed to hold growth in check for a time.—*R. S. Bromer.*

CHAUMET, G. Recherches complémentaires sur la tuberculose pulmonaire de l'adulte. (Complementary researches on pulmonary

tuberculosis of adults.) *J. de radiol. et d'électrol.*, Jan., 1930, 14, 42-47.

The various paths of extension of pulmonary tuberculosis in adults are discussed and the conclusion is arrived at that the propagation may occur either by perihilar diffusion, by interlobar pleuritis or by bronchial densification and ramification.—*T. Leucutia.*

ASSMANN, H. Infraclavicular foci of infiltration as evidence of incipient tuberculosis of the lungs in young adults. *Radiology*, Feb., 1930, 14, 93-98.

During the last eight years the author has encountered what he believes to be a characteristic type of pulmonary lesion in the early stages of tuberculosis of the lungs, particularly in young adults. The lesion, as seen with the roentgen ray, consists of an isolated rounded focus of varying density, usually situated just below the clavicle, in the lateral part of the pulmonic field, more rarely in the upper portion of the lower lobe. Such a lesion is usually sharply circumscribed and definitely contrasted but it may have little density and show a gradual transition into the normal pulmonic field. It is of fundamental importance to understand that, in contradiction of the generally accepted idea that tuberculosis of the lungs nearly always begins in the apices, the type of lesion described, the infraclavicular focus, is associated with absolutely normal apices. From this focus a general tuberculosis may develop, but with timely treatment a favorable prognosis may be given.—*J. D. Camp.*

MATHES, MARY E., REICHERT, F. L., and HOLMAN, EMILE. An experimental method for the radiographic demonstration of the bronchial and pulmonary arteries. *Proc. Soc. Exper. Biol. & Med.*, Jan., 1930, 27, 278-282.

To determine the exact conditions present within the pulmonary and bronchial circulation following the introduction of infected emboli, a method for the roentgen demonstration of the two circulations was developed. The bronchial artery is best injected with the lung *in situ*. Under chloroform or ether anesthesia the chest is opened by splitting the sternum exactly in the midline. Just before entering the



pleural cavity the animal is killed with the anesthetic to prevent injury to the inflated lung. The various arteries are ligated so as to limit the injection to the thorax. The most satisfactory injection mass is that of Hill using a suspension of 20 per cent bismuth oxychloride in an 11 per cent solution of gum acacia. Berlin blue was added to distinguish the bronchial from the subsequent pulmonary arterial injection. The heart and lungs are removed, the vessels remaining plugged with bismuth. The lung is then inflated to distend all areas without rupturing the air sacs. The lung is then deflated to an intrabronchial pressure of 10 mm. mercury which is the optimum respiratory distention of the canine lung. Stereoscopic roentgenograms of the injected lung enable one to study accurately the size and distribution of the bronchial artery. After this the pulmonary artery may be injected in the excised lung by inserting a cannula through the right ventricle into the pulmonary artery.—*B. Cohen.*

PRIESEL, RICHARD. Der Lobus venae azygos im Röntgenbilde. (The roentgen appearance of the azygos lobe.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Nov., 1929, 40, 804-809.

The author observed 5 cases of azygos lobe occurring in children (at the ages of  $2\frac{1}{4}$ , 4, 7, 9 and  $10\frac{1}{2}$ ). In one of the cases a post-mortem examination was performed by a special method (so as to preserve as much as possible the conditions in vivo) and it was found that the vena azygos showed a course which is entirely different from that usually observed. From this the author deduces that the azygos lobe is a developmental anomaly (due to anomalous development of the vena azygos).—*T. Leucutia.*

SINGER, S. Zur röntgenologischen Differentialdiagnose intrathorakaler Erkrankungen. (On the differential roentgen diagnosis of intrathoracic diseases.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Nov., 1929, 40, 787-798.

Three cases of intrathoracic lesions are described in rather lengthy detail in order to prove that the differential diagnosis of intrathoracic tumors still offers difficulties.

The first case was that of a tumor of the anterior mediastinum which was clinically diagnosed as a substernal thyroid and which on post-mortem examination proved to be an

aneurysm. In the second case the clinical diagnosis was that of a malignant tumor of the right lung complicated by pneumonia and the post-mortem examination revealed the presence of a lobar pneumonia (in the stage of hepatization) of the right upper and middle lobes without any evidence of tumor. The confusing factor in the roentgen diagnosis of this case was the lack of involvement of the upper portion of the right lung. This at post mortem proved to be due to the presence of an accessory venous azygos lobe. In the third case a clinical diagnosis of carcinoma of the bronchus with metastases to the mediastinal lymph nodes was made while at post mortem a lymphogranulomatosis of the mediastinum with extension to the roots of the lungs was found.

The author expresses the opinion that the diagnosis of intrathoracic tumor cannot be made on the basis of a roentgen examination alone.—*T. Leucutia.*

POPOVIĆ, LAZA. Studien aus der Bronchographie. (Studies on bronchography.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Nov., 1929, 40, 821-833.

Lipiodol enters the bronchial tree in the direction of the least resistance and under the influence of its own weight. If only a small quantity is injected at a time the accommodation of the bronchial tree to the foreign substance is gradual and without much reaction, but if a large quantity of lipiodol is injected at a time the reaction is very pronounced and may appear in the form of tonic spasms or severe peristalsis. The peristaltic waves are especially well brought out when the patient is lying on the side on which the lung is injected.

The mechanism of the spasms and peristalsis is described in lengthy detail.—*T. Leucutia.*

BORDET, EMILE. Les variations de l'ombre cardio-aortique dues a l'engraissement ou a l'amaigrissement. (Variations of the cardio-aortic shadow due to obesity or emaciation.) *J. de radiol. et d'electrol.*, Jan., 1930, 14, 33.

Since obesity leads to elevation of the diaphragm and emaciation to lowering of the diaphragm it is only natural that in such individuals the cardio-aortic shadow should present varying pictures. Generally speaking the variations resemble those of a normal heart

in deep expiration and inspiration and consequently they are of a mechanical geometric and not of a pathological character.—*T. Leucutia*.

GAUDIN, CHARLES. Orthodiagrammètre pour examens radioscopiques du cœur. (Orthodiagrammeter for radioscopic examinations of the heart.) *J. de radiol. et d'electrol.*, Jan., 1930, 14, 30-32.

Lian, Guénaux and Renault in 1925 presented a ruler for the determination of the angle of disappearance of the heart apex. The author has simplified this ruler (nomogram). The method of its use is briefly described.

The author has also constructed a special compass for the determination of the depth index of the apex of the heart. This is also described briefly and illustrated with photographs.—*T. Leucutia*.

STUMPF, PLEIKART. Die Isographie und Kinematographie des Herzens. (Isography and cinematography of the heart.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Nov., 1929, 40, 798-804.

In a previous article (see abstract, this Journal, April, 1929, p. 394) the author described in detail the procedures for the densographic and kymographic tracings of the heart.

In the present article a densographic table is presented which now automatically connects the points of equal densities of the heart shadow, the lines so obtained being called, because of their similarity to the contour lines of relief maps, isograms. Densography is of considerable value in the study of the volume changes of the heart, permitting conclusions of no small importance with respect to the massive hypertrophy of certain portions of the heart.

The author has also worked a new method for the kymography of the heart. This consists in placing a lead shield with small slits (1 mm. wide) at regular distances (every 12 mm.) between the patient and the roentgen film and in moving the film (by means of a motor, in a direction perpendicular to the slits and for a distance corresponding to the space between the slits) during the time of actual exposure. The roentgenograms so obtained are called surface kymograms. They can be studied either as flat films for the changes in the contour of the various portions of the

heart, or as moving films, for the changes in shape of the entire heart. In this latter case a special optical device is used if the viewing is done individually or cinematography if the film is demonstrated to a larger audience. The optical procedure consists in viewing the film (which is moved in front of a lamp behind a shield provided with slits at distances exactly identical to those used on the lead shield) through rotating glass cubes which serve the purpose of enlarging the individual images projected through the small slits until the impression of a continuous image is obtained. For the cinematographic reproduction of the surface kymograms a specially constructed apparatus, the cinegraph, is used which permits the automatic printing of the moving kymogram with any speed desired.

The conclusion is reached that densography is of value in accurately registering the changes in mass (density) of the heart while surface kymography permits the analytic study of individual portions of the heart both from a morphologic and functional standpoint.—*T. Leucutia*.

RITVO, MAX. Hernia of the stomach through the esophageal orifice of the diaphragm. *J. Am. M. Ass.*, Jan. 4, 1930, 94, 15-21.

An "esophageal orifice hernia" is a protrusion of the stomach through the esophageal opening of the diaphragm into the thorax. Roentgenographic examination with the opaque meal has made this diagnosis more common. Sixty cases were found by the author among 8000 gastrointestinal cases. The condition is either congenital or acquired. The size of the hernia in the cases reported varies from that of a walnut to one involving half of the stomach. Forty-one were females and 19 were males. Ages varied from twenty-one to seventy-two years, but only adults had been examined.

Symptoms most suggestive of this condition are pain in the epigastrium and a sensation of distress following the first few mouthfuls of food. This is relieved by walking or taking a hot drink. Other symptoms are detailed. Roentgenographic examination is the most accurate means of diagnosis. The opaque meal plus the use of the horizontal rather than the upright position is stressed. Differential diagnosis clinically is from gastric and esophageal carcinoma, peptic ulcer, gall-bladder disease

and angina pectoris. Roentgenographically diaphragmatic hernia of other types, lower esophageal and gastric diverticula, cardiospasm, cardio-esophageal relaxation and even-tration must be excluded.

Treatment is chiefly dietetic and preventive. Surgery is indicated only in the rarer cases of severe symptoms.—G. R. Miller.

#### ABDOMEN

DIOLÈS. Compresseur et appareil sélecteur pour l'étude du relief tractus digestif. (Compressor and selective apparatus for the relief study of the digestive tract.) *J. de radiol. et d'électrol.*, Jan., 1930, 14, 49-53.

The author describes in detail the compressor as well as the apparatus which he uses for the roentgen examination of the digestive tract. The method of procedure is briefly as follows: Following the ingestion of 200 gm. gelobarium, the usual roentgenoscopic examination is made. If there is indirect evidence of ulcer, the point of pain is exactly localized and by means of the selector serial roentgenograms (in a vertical position without compression) are taken. The films are immediately developed and if the lesion is not visible additional roentgenograms are taken in the horizontal position with application of the compressor. In exceptional cases a series of stereoroentgenograms is also made.

It is hoped that by this procedure many lesions which heretofore have remained undetected can be demonstrated roentgenologically, thus improving the method of accurate diagnosis.—T. Leucutia.

BERG, HANS H. Reliefstudien am Magen-darmkanal. (Relief studies of the gastrointestinal canal.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Nov., 1929, 40, 844-855.

This is a lecture delivered at the Twentieth Annual Meeting of German Roentgenologists in Vienna in April, 1929. The value of relief diagnosis in tumors, ulcers, and inflammations of the gastrointestinal tract as well as in certain changes of the neighboring organs was demonstrated by means of numerous roentgen slides, some of which are reproduced.—T. Leucutia.

DARBOIS, HUET, J. -A., and SOBEL. A propos du diagnostic radiologique de la syphilis

gastrique. (The roentgen diagnosis of gastric syphilis.) *J. de radiol. et d'électrol.*, Jan., 1930, 14, 47-49.

Gastric syphilis may present (a) the ulcerous, (b) the stenosing, and (c) the sclerous-gumous or the diffuse sclerous forms.

The three forms are briefly discussed and 7 cases of gastric syphilis which were observed by the authors are included.—T. Leucutia.

BROC, RENÈ, and JAUBERT DE BEAUJEU, A. Biloculation congénitale de l'estomac avec une poche intrathoracique ou hernie du hiatus diaphragmatique. (Congenital biloculation of the stomach with an intrathoracic pocket or hernia of the diaphragmatic hiatus.) *J. de radiol. et d'électrol.*, Jan., 1930, 14, 13-22.

A case of biloculation of the stomach is described in a boy five years of age. The condition was discovered accidentally during an examination for whooping cough which had failed to clear up. The boy developed attacks of vomiting following the intensive cough and the roentgen examination was made to learn the cause of the vomiting spells.

Roentgenoscopy of the chest revealed an epiphrenic pocket situated to the right of the heart which on examination by means of a barium meal proved to communicate freely with the stomach, giving the impression of a biloculation of the stomach. According to Åkerlund such a roentgenoscopic picture is characteristic of two conditions: (1) congenital epiphrenic diverticulum of the esophagus, and (2) gastric hernia through the diaphragmatic hiatus. According to the authors a third condition, that of congenital biloculation of the stomach, must be included. The importance of these three conditions is discussed and their mechanism is illustrated by schematic drawings.—T. Leucutia.

DWYER, MAURICE F., and BLACKFORD, JOHN M. Interpretation of gastric symptoms. *Radiology*, Jan., 1930, 14, 38-43.

The conclusions drawn from a study of 3000 consecutive patients requiring a gastrointestinal examination are presented. It is well known that the majority of patients who complain of gastric symptoms do not have organic disease and this is corroborated by the present series.



Only 15 per cent of the patients had organic lesions of the stomach or duodenum to account for the symptoms; duodenal ulcer was found in 8.1 per cent and was the most common organic finding in the stomach or duodenum. Gastric ulcer was only a fifth as common as duodenal ulcer. Cancer was found in 3.6 per cent of the patients who had gastric symptoms; 80 per cent of the cancers apparently originated in a resectable area of the stomach. Disease of the gall-bladder was the most frequent cause of the symptoms, and was regarded as responsible for the dyspepsia in 21.3 per cent. In 59 per cent of all cases the cause of dyspepsia was not due either to functional or organic conditions in the stomach, duodenum or gall-bladder.—*J. D. Camp.*

FANARDSHEW, BARTHOLOMÄUS. Zur Frage der Nischendiagnostik bei Ulcus duodeni. (The diagnosis of niches in duodenal ulcer.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Dec., 1929, 40, 1088-1096.

For the past two years the author has routinely used Berg's method for the roentgen diagnosis of duodenal ulcer and found that the examination in the second oblique position with direct graduated bulbar compression is of considerable value, especially in the ulcers localized to the anterior and posterior walls of the duodenum.

Several cases are briefly described and illustrated with roentgenograms in order to prove the value of the method. In connection with this it is emphasized that a complete filling of the duodenal bulb is essential for the demonstration of ulcers localized to the anterior or posterior walls of the duodenum. The evidence of a concavity around the niche signifies the presence of an old ulcer callosum. This concavity is especially marked in the ulcers of the anterior wall, while in ulcers of the posterior wall it might be entirely absent.

The examination in the second oblique position occasionally leads to the detection of niches in the anterior or posterior recessus.

The rather infrequent aboral bulbar ulcers usually lead to megabulbus. In such instances an examination with marked compression is necessary. An irregular serrated contour of the duodenal bulb indicates the presence of an ulcer.

Gas in the hepatic flexure (of the colon) or

ascaris worms (in the duodenum) occasionally lead to considerable deformity of the bulb giving the impression of a niche.

If there is a lateral kinking of the descending portion of the duodenum the visualization of the bulb in the second oblique position may become very difficult. The best demonstration of a relief niche is obtained with graded compression applied sagittally to the bulb.—*T. Leucutia.*

VORHAUS, MARTIN G. Recognition of some of the less common diseases; duodenal-jejunal diverticula; mucocoele of the appendix and the cecum. *J. Am. M. Ass.*, Jan. 18, 1930, 94, 165-169.

The literature of duodenal-jejunal diverticulum is reviewed. One case of true diverticulum and one case of pseudodiverticula are reported. Both were diagnosed roentgenographically, the former correctly, the other incorrectly because of the appearance suggested by pinching of bits of the jejunum by adhesions.

The literature of mucocoele of the appendix is reviewed. A case is reported which showed roentgenographically a patent opening between the cecum and the dilating mucus-secreting portion of the appendix. Hence the condition can form in the presence of bacteria. Attacks of symptoms were recurrent before operation.—*G. R. Miller.*

FRIEDENWALD, JULIUS, MORRISON, THEODORE H., and FELDMAN, MAURICE. Chronic duodenal stasis observations in twenty-four cases. *Am. J. M. Sc.*, Dec., 1929, 178, 796-805.

This is a consideration of the etiology, incidence, symptomatology, diagnosis and treatment of chronic duodenal stasis as based upon observation in 24 cases.

As to etiology, aside from congenital factors, the following condition favor its formation; adhesions, compression of the duodenum and prolapse of the colon into the pelvis. In addition, spinal deformities, growths involving the abdominal organs and pressure due to ptosis of the right kidney are at times responsible for the condition. According to Bloom and Arens as well as others, chronic duodenal stasis should not be considered as a distinct clinical entity, but only as a roentgenologic phenomenon the result of lesions such

as cited above. This view, however, has not been accepted by most authorities.

As to incidence, the condition may occur at any age but is most common during middle life. It occurs twice as frequently in women as in men, although in the series here reported there were 18 males and 6 females.

The symptomatology is not usually characteristic. There are periodic attacks of nausea and vomiting, so-called bilious attacks. There is usually constipation with occasionally periods of diarrhea. Change in posture may afford relief of symptoms. Loss of weight and strength is not unusual and neurasthenic manifestations are common. During the interval of freedom from attacks, the patient ordinarily enjoys good health. As the disease becomes more chronic, the dilatation extends into the stomach, when nausea and vomiting become persistent. Headaches and migraine attacks are not infrequent. In the more aggravated types a high degree of toxemia may develop.

The condition is at times associated with peptic ulcer, cholecystitis, pancreatitis and mucous colitis, the first of these being the most frequent.

As to diagnosis, the patients are frequently of the asthenic habitus and usually have visceroptosis. The roentgen examination affords the best and often the only means of diagnosis. The fluoroscopic observation gives the most information and this is most satisfactorily made with the patient in the upright posture when viewed semilaterally with the right side nearest the screen. However, the obstruction can ordinarily also be well observed when the patient is recumbent and satisfactory films may be obtained in either position. Retention in the duodenum can be considered positive when the barium is retained longer than a period necessary to complete the passage of the two gastric-peristaltic waves. In marked cases gastric and duodenal six-hour residues are not uncommon. The dilated duodenum can frequently be most satisfactorily observed from one to two hours following the barium meal. Antiperistalsis with regurgitation into the stomach may be noted. A rather characteristic picture is observed four or five hours following the barium meal in the form of a saucer-shaped residue in the second and third portions of the duodenum.

In considering the diagnosis it should be

recognized that duodenal stasis is not a rare condition and that it is not infrequently overlooked. It is always important in order to be certain that the stasis is permanent that repeated roentgen examinations be made. In all obscure forms of migraine a thorough roentgen study of the duodenum should be made.

As to treatment, in many instances medical management is quite satisfactory and with conservative and postural treatment marked improvement frequently takes place. The cases due to visceroptosis are especially amenable to medical treatment.

When the symptoms are severe or when adequate medical treatment no longer suffices in affording relief, surgical intervention is indicated, the most satisfactory procedure in most instances being duodenojejunostomy. When performing this operation, it is most important to undertake a complete investigation of the abdominal viscera so that all complications may as far as possible be corrected during the time of this procedure. Of the 24 cases in this study, 23 were treated medically with at least satisfactory temporary relief.—*Karl Kornblum.*

BARGEN, J. ARNOLD, COPELAND, MURRAY M., and RANKIN, FRED W. Tuberculosis of the sigmoid colon simulating a primary malignant lesion. *Ann. Surg.*, Jan., 1930, 91, 79-84.

The authors report two cases of tuberculosis of the sigmoid colon. They report these cases because of the rare occurrence of tuberculosis of the sigmoid colon, the infrequency of tuberculous peritonitis with tuberculosis of the colon, its close similarity to other obstructive lesions of the colon, and the difficulties encountered in its diagnosis. In each case the roentgenograms showed a filling defect which was supposed to be due to carcinoma.

In commenting on these cases the authors state that tuberculous lesions of the colon, as a primary disease, have been reported. When they occur their site is usually the ileocecal region. Tuberculosis of the sigmoid colon is one of the rare forms of tuberculosis of the colon. Definite proof does not exist that the primary lesion in these 2 cases was in the sigmoid colon but several observations suggest this. The surgeons who performed exploration in these cases noted that the greater bulk of the lesion was in the left lower part of the abdomen.

Obstruction occurred in the sigmoid colon. The absence or scantiness of the bleeding in the presence of a large obstructive lesion argues against the presence of a malignant condition. Rankin and Yeomans previously have noted the similarity of the roentgenographic defects produced by tuberculous and malignant lesions. The absence of tuberculous lesions elsewhere than in the sigmoid colon is noteworthy. With these facts in mind, it would seem hardly necessary to search for two types of lesions, that is, for both a malignant and a tuberculous condition to explain the pathologic data.

Yeomans previously made an interesting observation, that tuberculous ulcers of the sigmoid colon encircle the bowel, following the course of the blood vessels as in the ileum. This might explain the similarity of the filling defect as detected roentgenologically, in certain malignant and tuberculous lesions.—*R. S. Bromer.*

GINZBURG, LEON, and BENJAMIN, EMANUEL W.  
Lipiodol studies of post-operative biliary fistulae. *Ann. Surg.*, Feb., 1930, 91, 233-241.

During the past two years the authors have on a number of occasions injected lipiodol into postoperative biliary fistulae and then made roentgen studies of the biliary tract. When the films indicated the presence of pathological conditions they were able to check them against the operative findings.

**Technique of Injection.** In order to evaluate correctly the anatomical conditions present, sufficient lipiodol to distend the ducts must be injected. They have made the injections in their later cases under roentgenoscopic control. This gives a fairly accurate idea of the flow of the injected fluid, prevents over-distention, and reveals any false dissection of the tissue spaces. Prior to the injection, the lipiodol is warmed, and whatever bile is present in the sinus is aspirated. If a tube is still in situ, gravity will suffice to outline the ducts. The tube should be removed, however, before a roentgenogram is made, as it may obscure the picture.

Usually, however, the patient is seen with a small skin opening and a narrow tortuous tract. In these cases it is frequently necessary to use some degree of pressure in order to force the lipiodol into the duct system. For

this purpose they use a "Triumph" syringe with a rubber urethral tip attached to its nozzle, and inject under roentgenoscopic control.

Minor points to be emphasized are: the necessity of having the skin wiped dry of lipiodol before the roentgen exposure is made in order to avoid superposition of shadows of the lipiodol lying on the skin surface; the marking of the skin surface by a lead marker or otherwise in case there is a tendency for the contrast medium to collect in a pool in the subcutaneous tissues; the exit of the sinus should be plugged and strapped over to prevent the lipiodol from flowing out of the tract.

They have encountered no untoward effects from the injection of the lipiodol, either locally or generally. Even in cases where they injected under considerable pressure and where there was no communication with the duodenum, later roentgenograms have shown that the lipiodol completely disappeared from the intrahepatic radicles. Whether this is due to reflux through the sinus or whether the hepatic cells have the power of absorbing lipiodol, they are unable to state. In cases where there is a direct communication between the duct system and the duodenum they have noted no evidence of gastrointestinal irritation, even when lipiodol has been used in quantities up to 20 c.c. They have not made any injection in the presence of fever, and believe that it would be inadvisable to attempt one in the face of any active infectious process in the liver or ducts.

**Interpretation.** In some instances the presence of a postoperative biliary discharge may be the external evidence of an obstruction to the normal flow of bile. Considerable light on the nature and site of such obstruction may be obtained by the injection of lipiodol.

If no obstructing lesion is present the injected lipiodol will pass almost immediately into the duodenum. The sphincter of Oddi does not seem to offer any obstruction to its onward flow. Only a few of the primary ducts are outlined. In the absence of an obstruction it is impossible to outline the intrahepatic biliary radicles to any extent, as the flow meets with much less resistance distally than centrally. So rapidly does the lipiodol pass into the duodenum that the entire common duct is rarely outlined completely. The duodenum is rec-

ognized by its serrated edges due to its normal folds and by the peristalsis stimulated by the inflow of the fluid into the lumen. At times the lipiodol passes very rapidly into the jejunal loops, lying on the left side of the abdomen, so that the presence of the opaque fluid in the intestine may be overlooked unless the roentgenogram includes the entire upper abdomen.

When no obstruction can be demonstrated an early spontaneous closure of the fistula may be anticipated. In 5 cases where the lipiodol showed no obstruction in the bile passages, the biliary discharge gradually ceased and the sinus closed without any further intervention. When an obstruction is present distal to the internal fistulous opening, the lipiodol meeting resistance distally, backs up into the proximal biliary radicles, and may outline the entire biliary tree. This is especially true in obstructions in the hepatic duct. When the obstruction is low down in the common duct, the dilatation of the duct may be so great that it will accommodate all the injected lipiodol and one should hesitate about injecting more fluid to outline the intrahepatic radicles. If the obstruction is complete no lipiodol will be visualized in the intestine either immediately or in later pictures. With an incomplete obstruction small quantities of fluid will trickle through to the duodenum. Lipiodol will demonstrate not only complete obstructions where the stool is alcholic but also incomplete obstructions where the stool contains bile. It will thus demonstrate incomplete strictures and non-impacted stones.

The nature of the obstruction must be arrived at by inference. The most common causes postoperatively are retained stone and complete or incomplete stricture. A small overlooked carcinoma of the head of the pancreas or of the papilla of Vater may at times be the cause. Postoperative strictures, usually traumatic in nature, occur practically only in the supra-duodenal portion of the duct and most commonly at the junction of the cystic and hepatic ducts. Retained common duct stones, on the other hand, cause obstruction near the papilla. An obstruction high in the common or the hepatic duct is more likely to be a stricture. Obstruction low down where the whole common duct is distended and visualized is more likely to be due to a stone. A stone may, but does not necessarily, cause a

filling defect in the lipiodol shadow. It is more apt to do so if tightly wedged in a small duct, where the lipiodol cannot surround it, than if it is lying in a distended one where the dense lipiodol shadow will obliterate all finer details.

Lipiodol may be of some assistance in determining the operative procedure. If the stump of the hepatic duct is too short it will of course be impossible to anastomose the short stump to the duodenum or lower portion of the common duct. On the other hand, if sufficiently long it will indicate that an anastomosis of the stump to the lower end of the duct or to the duodenum is technically feasible.—*R. S. Bromer.*

BENHAMOU, ED., and MARCHIONI, R. Radioscopie et radiographie de la rate. (Roentgenoscopy and roentgenography of the spleen.) *J. de radiol. et d'électrol.*, Jan., 1930, 14, 33-42.

The authors present numerous roentgenograms illustrating the value of the routine roentgen examination in the different diseases of the spleen. In certain instances an enlargement of the spleen is observed already at roentgenoscopy while in others this is discovered only at roentgenographic examinations with serial films. The best technique is to place the patient on his stomach on a Bucky diaphragm and to take a roentgenogram during deep expiration, the tube being centered to the mid-portion of the last intercostal space on the left side posteriorly. The time of exposure must be very short. No special preparation and no insufflation are necessary. The authors are of the opinion that the use of pneumoperitoneum is indicated only in exceptional cases.—*T. Leucuttia.*

#### GYNECOLOGY AND OBSTETRICS

LYNCH, FRANK W. Uterine fibromyoma. *J. Am. M. Ass.*, Jan. 18, 1930, 94, 156-162.

Three hundred and ninety-four cases of large fibroids (greater than a four months pregnancy) and 289 cases of small fibroids are reviewed.

One-fourth of the large tumors occurred between forty-five and fifty years; sixty-one per cent were in women under forty-four years. Family history is unimportant. Past history of both large and small types discloses that many of the women have uterine and thyroid deficiency. The cardinal symptom was



hemorrhage in one-third of the cases, pain or pressure in one-third, while no symptoms directly referable to the tumor were found in the remaining third. Not all submucous fibroids showed hemorrhage, and many fibroids not submucous produce bleeding. Tumors developing earlier in life grew more rapidly than those developing in later years. Early diagnosis has reduced the danger from degeneration. Hemorrhage now is the chief factor militating against the patient.

Possibly sterility is pre-existent, and the type of endocrine disturbance which causes it also causes the formation of the tumor.

Of the entire series (683 cases) 4.6 per cent showed malignancy complicating the fibroid.

Surgery, radium and roentgen therapy each has its place in treatment. The first was accompanied by a mortality of 1.34 per cent in this series while one death occurred in the cases treated with radium.—*G. R. Miller.*

#### SKELETAL SYSTEM

KIENBÖCK, ROBERT. Über schwere infantile Polyarthrits chronica und ihre Folgeerscheinungen—allgemeiner Wachstumsstillstand und Mikromelie "Pseudoachondroplasia." (On severe chronic infantile polyarthrits and its sequelae—general arrest of development and micromelia "pseudoachondroplasia.") *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Nov., 1929, 40, 813-816.

The author presents the report of the post-mortem examination of a case which he has repeatedly described previously and which consisted in a very severe polyarticular joint affection with marked secondary disturbances. The condition started at the age of eight with febrile polyarthrits and after several recurrences resulted in a general arrest of growth of the body with kyphoscoliosis, shortening of all extremities, numerous ankyloses, generalized osteoporotic atrophy of the skeleton, kidney calculi and diaphragmatic hernia. In 1902 when the patient at the age of thirty-two was first examined by the author, a very unfavorable prognosis was given. Notwithstanding this fact, the patient lived until 1929, to the age of nearly sixty, and died as the result of an intercurrent disease (carcinoma of the esophagus).—*T. Leucutia.*

JAULIN, and LIMOUZI. Luxation congénitale bilatérale de la tête du radius. (Bilateral congenital subluxation of the head of the radius.) *J. de radiol. et d'électrol.*, Jan., 1930, 14, 27-29.

The authors describe briefly a bilateral congenital subluxation of the head of the radius in a boy fifteen years of age. The roentgenograms are presented.

The condition may be the result of trauma in utero, injury during delivery, oligoamnios, disturbance of muscular equilibrium due to nerve lesions and intoxications (alcohol, lead).—*T. Leucutia.*

MICHAJLOW, MICH., and TSCHEREPNINA, M. Über die Wirbelknorpelinseln und deren Röntgenbild. (The cartilaginous islands of the vertebrae and their roentgen appearance.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Dec., 1929, 40, 1061-1069.

The anatomical sections of 70 vertebral columns were examined as to the incidence and pathology of the cartilaginous islands. After fixation of the spine in formalin, roentgenograms in the anteroposterior and lateral views were made, then the spine was cut sagittally and the cross-sections photographed.

In 14 cases there was no evidence of pathological changes, in 27 there was evidence of alterations within the epiphyses and vertebral bodies and in 29 there were cartilaginous islands. Only 5 of the cartilaginous islands presented typical roentgen pictures.

The author is of the opinion that the cartilaginous islands are either of traumatic origin or the result of irregular enchondral ossification. In the first instance, there is always evidence of an injury to the cartilaginous plate, due to trauma or to congenital fragility of the cartilaginous structures; in the second instance, there is an irregular proliferation of the cells of the cartilaginous plates into the bodies of the vertebrae. The two processes very often present identical anatomic and roentgenologic pictures.—*T. Leucutia.*

SANTOS, JOSÉ V. Giant cell tumor of the spine. *Ann. Surg.*, Jan., 1930, 91, 37-43.

The author reports a case of giant cell tumor of the spine for three reasons: (1) it is relatively uncommon in the spine; (2) its diagnosis is not

easily made, and (3) there is a marked destruction with collapse of the affected vertebra.

He found, including the case reported in this paper 23 cases of primary giant cell tumor of the vertebra in the literature. The roentgenograms present a characteristic circumscribed area of diminished density with fine fibrillary lines of ossification within the tumor. A secondary collapse of the vertebral body, as in this present case, however, has not been noted before. This case emphasizes the importance of biopsy in establishing a diagnosis and demonstrates that where there is marked destruction and collapse of the vertebra, roentgenograms alone would not be of much diagnostic value in differentiating it from a metastatic malignant lesion.

The lesion, occurring relatively more frequently at the lumbar spine, shows greater tendency to increase rapidly and heal more readily by ossification, spontaneously or following partial removal, when located at the cervical and lumbar spines. All the cases where the cervical and lumbar vertebrae formed the site of the lesion, reveal extension through the vertebrae into the surrounding musculature with the consequent formation of a palpable soft mass within a year of the onset of symptoms. Subsequently an extensive ossification of the lesion occurs spontaneously, or following an incomplete removal. In a way this would indicate that they differ in some respect from the giant cell tumors occurring in long bones, which, as a rule, do not ossify, although ossification is also often noted following pathological fracture through the site of the lesion. This fact and the frequent occurrence of early and extensive ossification of giant cell tumors located in the lumbar and cervical vertebrae, which are undoubtedly the most mobile portions of the spinal column, is so striking and suggestive that it seems that stress and strain may be a probable cause of the enhanced ossification. The associated urinary disturbances which are found in most of the cases reported, as a rule ultimately disappear, although they may persist for a long period of time.—*R. S. Bromer.*

SGALITZER, MAX. Röntgenologische Studien zum Nachweis der Wirbeltuberkulose in einem frühen Stadium. (Roentgen study for the demonstration of tuberculosis of the

vertebrae in an early stage.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Nov., 1929, 40, 761-786.

Two forms of tuberculosis of the vertebrae are described: (a) the early form without marked deformities of the spinal column, and (b) a mild, very chronic form, the so-called spondylitis tuberculosa benigna.

(a) The earliest symptoms of tuberculosis of the vertebrae consist in a slight decrease of the physiologic lordosis of the cervical and lumbar portions or a slightly increased kyphotic curvature of the thoracic portion of the spine according to whether the cervical and lumbar, or the thoracic segments of the vertebral column are involved. In other instances there is a central focus of destruction within the body of the vertebra first without any change in the normal alignment, later with collapse of the vertebral body and subsequent deformity of that particular portion of the spine. If the tuberculosis is localized to the thoracic spine, in 80 per cent of the cases there is evidence of a cold abscess at the site of the lesion. This abscess extends in a fusiform shape to both sides of the spine and its widest diameter is, as a rule, at the level of the tuberculous focus. Its differential diagnosis includes thymic enlargement, retrosternal goiter, mediastinal tumor, enlarged bronchial lymph nodes, tumors and diverticula of the esophagus, enlarged right auricle, dilated aorta descendens, mediastinal adhesions, aneurysms of the aorta and sarcoma of the vertebrae. The demonstration of a cold abscess in the cervical and lumbar regions of the spine is possible only in a very limited number of cases.

(b) The spondylitis tuberculosa benigna as a rule extends over a period of years without producing any noticeable symptoms and without leading to deformities of the spine. In some instances there is spontaneous healing. The diagnosis of this form of tuberculosis is based on the same criteria as that of the early forms. In this respect the demonstration of a cold abscess is of special value.

Twelve cases, briefly described, are included as examples of the various forms of tuberculosis of the spinal column. The article is richly illustrated with roentgenograms and diagrams.—*T. Leucutia.*

RUTH, C. E., and RUTH, V. A. Fractures of the hip. *J. Am. M. Ass.*, Jan. 18, 1930, 94, 169-174.

Treatment of hip fractures should be carried out at a hospital. Transportation causes less shock when a Thomas splint is employed. Diagnosis is most satisfactory and least traumatizing by roentgen examination. By this means it can be determined which one of the following six types of fracture is present: (1) Fractures of the head of the femur within the acetabulum; (2) acetabular fractures; (3) fractures of the shaft with separation of the lesser trochanter from both fragments; (4) intertrochanteric fractures in which the lesser trochanter is attached to the proximal fragment; (5) fractures of the base of the neck in which the lesser trochanter is attached to the distal fragment; (6) fractures of the narrow part of the neck.

Various factors influence the deformity and reduction of each of the above. All unnecessary tax upon the patient's strength must be avoided in the treatment of these cases, and a proper consideration of details in a strictly observed routine which minimizes and eliminates a general anesthetic is indispensable to success.

Traction is maintained constantly from one to three weeks, after which time a cast may be applied, also without general anesthetic. Open surgical reduction is condemned. Should union fail in fractures of the neck, however, excision of the femoral head is the most satisfactory procedure.—G. R. Miller.

MEYER, M., and SICHEL, D. Étude radiographique d'un cas de mycose osseuse

ciated with thickening of the periosteum. The lesions although interesting are not characteristic and the only way to make a positive diagnosis is by bacteriological studies.—T. Leucutia.

SUTHERLAND, CHARLES G. Roentgenographic characteristics of lesions of bone. *J. Am. M. Ass.*, Dec. 28, 1929, 93, 2024-2026.

Before interpretation of bone lesions is attempted perfection of the roentgenogram is essential. Anteroposterior and lateral views, plus a roentgenogram of the unaffected side for comparison, are all desirable. Artefacts must also be ruled out.

Malignant lesions denude the periosteum and invade soft tissue. Benign lesions never do this. Early sclerosing osteogenic sarcoma may resemble osteomyelitis and syphilitic osteitis but the sarcoma will usually show a cortical break. Ewing's type of sarcoma shows "onion skin" lamination of the periosteum plus a uniform expansion of the shaft of the long bone. Invasion of soft parts is not marked. Periosseous fibrosarcomas show areas of absorption in the bone. The shadow of soft tissue is well encapsulated.

Multiple myelomas need roentgenograms of more than one part for diagnosis. There are numerous vacuolated areas throughout the bones, each sharply demarcated. The latter appearance differentiates it from osteoclastic metastasis from mammary carcinoma.

Metastatic lesions may be osteoclastic or osteoplastic. The former give a "melted ice" appearance to the bone. Rarely the two forms are combined. Most commonly osteo-

bone and narrowing of the anterior borders of the vertebral bodies.

Sarcoma and osteochondritis of the spine may be confused.

Exostosis, osteoma, chondroma and osteochondroma differ in the variations in density.

Fibrocystic disease and giant cell tumor should be differentiated, according to the author. In the former, involvement is usually more extensive and frequently multiple, trabeculation is constant and the expansion of the shaft is more symmetrical.

Multiple congenital exostosis may be a developmental defect with resulting deformities rather than true neoplasm.—G. R. Miller.

KOPYLOW, M. B., and RUNOWA, M. F. Ein Beitrag zur Kenntnis der Marmorknochenkrankheit. (A contribution to the knowledge of marble bones.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Dec., 1929, 40, 1042-1054.

A case of marble bones is described in a man twenty years of age. Roentgenograms of the hands, feet, ankles, knees, pelvis and spine (which are reproduced) revealed that the process extended practically to the entire skeleton, both the spongiosa and corticalis having been involved. The femora, the right pubic bone and the left scapula presented signs of old healed pathologic fractures.

In connection with this case the author performed numerous investigations concerning the changes in the calcium, phosphoric and magnesium metabolism and found the following figures:

	Marble Bones per cent	Normal Bones per cent	Rickets per cent
Calcium . . . . .	29.94	24.31	21.30
Phosphate . . . .	10.12	33.30	30.54
Magnesium . . . .	0.72	0.10	0.53

The values of potassium, sodium chloride, sugar, cholesterin and uric acid of the blood were within normal limits.

The conclusion is reached that marble bones, similar to Paget's disease, is an alteration of the calcium and phosphoric metabolism consisting in hypercalcemia and hyperphosphoremia. In this respect they are antagonistic to rickets and osteomalacia which as is known consist in hypocalcemia and hypophosphoremia. For the same reason the authors prefer to

place marble bones in the group of avitaminoses.—T. Leucutia.

PAISSEAU, LAQUERRIÈRE and SCHÉRER. Radiographies d'un cas un peu particulier de sclérodermie. (Roentgenograms of a somewhat peculiar case of sclerodermia.) *Bull. et mém. Soc. de radiol. méd. de France*, Nov., 1929, 17, 278-279.

A girl twelve years of age who for a period of three years was affected with generalized sclerodermia presented rather peculiar bony changes in the roentgenograms of various parts of the body. The changes were localized chiefly to the bones of the legs, hands, wrists and forearms and they consisted in marked demineralization with disappearance of the interarticular lines and with slight deformity. There was also involvement of one of the clavicles and there was evidence of calcareous deposits within the lungs and in one of the knee joints.—T. Leucutia.

FUSARI, A. Tubercolosi dell'articolazione acromio-clavicolare. (Tuberculosis of the acromio-clavicular joint.) *Radiol. med.*, Dec., 1929, 16, 1188-1191.

Generally tuberculosis of the shoulder is considered synonymous with tuberculosis of the scapulo-humeral joint. But the author calls attention to the fact that this is not true, but that the disease may be in the acromio-clavicular joint. He describes an illustrative case in a woman aged forty-five who had had tuberculosis of the cervical lymph glands in childhood and in 1928 began to have pain in the right shoulder irradiating along the arm. The function of the shoulder-joint was not impaired. Swelling of the deltoid region developed and in November a large abscess appeared and was evacuated. The scapulo-humeral joint was then immobilized but as the condition persisted she was sent for roentgen examination. It showed a tuberculosis beginning in the acromion process, which was very much atrophied, and extending to the acromio-clavicular joint. The scapulo-humeral joint was normal. Wassermann negative, tuberculin reaction positive. The joint was immobilized and treated with local heliotherapy and a year later there was advanced repair of the lesion.

It is important clinically to differentiate



between these two localizations of the disease for if the process is localized in the scapulo-humeral joint the shoulder must be immobilized in extreme abduction so that as much movement as possible is preserved when the joint becomes ankylosed while if the acromio-clavicular joint is affected a simple Désault's bandage is sufficient.—*A. G. Morgan.*

CODET and KAUFFMANN. Un cas d'ostéochondromatose du coude. (A case of osteochondromatosis of the elbow.) *Bull. et mém. Soc. de radiol. méd. de France*, Nov., 1929, 17, 276-277.

A case is briefly described in a man forty-eight years of age and in connection with this the differential diagnosis from similar lesions is discussed. The grape-like arrangement of the calcareous deposits in the roentgenogram is typical for osteochondromatosis.—*T. Leucutia.*

ALQUIER, A. Enchondromes multiples des deux mains. (Multiple enchondromas of both hands.) *J. de radiol. et d'électrol.*, Nov., 1929, 13, 619-620.

A case of multiple enchondroma of both hands is described in a young man who by occupation was a watchmaker. The condition had been present for a period of many years and he requested an examination since it bothered him in his professional work. The roentgenogram of the left hand showing the extensive lesions of nearly all the metacarpals and phalanges is reproduced. Further roentgenograms of the extremities and especially of the feet were however negative.

No treatment was advised since the tumors of the hand did not influence the general health of the patient.—*T. Leucutia.*

WEIL, S. Eine ungewöhnliche Form der multiplen Wachstumsstörung der Finger im Adoleszentenalter. (Unusual form of multiple developmental disturbance of the fingers in adolescence.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Oct., 1929, 40, 671-673.

An unusual developmental disturbance of the finger bones is described in a boy aged fifteen. The roentgenogram of the hands revealed a deformity of the head of the first phalanx of the third and fourth fingers on both hands,

clinically resulting in a swelling of the fingers.

The fact that the lesion occurred in adolescence and symmetrically on both hands suggests the possibility of Fleischner's disease (a condition analogous to Köhler-Perthes' disease).—*T. Leucutia.*

SCHRADER, ERWIN. Dreigliedrige Daumen. (Three-jointed thumbs.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Oct., 1929, 40, 693-694.

Two cases of thumbs with three phalanges on both hands are briefly described and their roentgenograms presented.—*T. Leucutia.*

PIFFAULT and BARREAU. Radiographies des mains. Lésions des phalangettes. (Roentgenograms of the hands. Lesions of the terminal phalanges.) *Bull. et mém. Soc. de radiol. méd. de France*, Nov., 1929, 17, 270-272.

A peculiar destruction of the terminal phalanges of both hands which occurred following sudden change of temperature (from cold to warm) is described in a Moroccan negro twenty-seven years of age.—*T. Leucutia.*

BELOT, KIMPEL and NEBOUT. Un cas rare d'ectrodactylie. (A rare case of ectrodactylia.) *Bull. et mém. Soc. de radiol. méd. de France*, Nov., 1929, 17, 274.

The various types of ectrodactylia hitherto described are: lobster claw, absence of the thumb and its metacarpal, monodactylia (only the first or fifth finger being present), and radial or cubital ectrodactylia with absence of either radius or ulna and occasionally of the metacarpal and even carpal bones. The author observed a case of absence of the middle finger which is not included among the above anomalies and which has not previously been described in the literature. The case is unique.—*T. Leucutia.*

HALLERMANN, W. Zur Kenntnis der Ostitis deformans Paget der Wirbelsäule. (On the knowledge of osteitis deformans Paget of the spinal column.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Dec., 1929, 40, 999-1017.

Whereas the generalized form of osteitis deformans Paget is exceedingly rare, the localized form, involving various segments of the

spine, is rather common. Between May, 1926, and August, 1929, the author was able to collect 70 cases of osteitis deformans Paget localized to the spine. In 90 per cent of the cases the lesion was confined to the spine alone, while in the other 10 per cent other bones of the body were also involved.

The study of the author was based on anatomical specimens which subsequently were roentgenographed. It was found that the changes in the anatomical specimens consisted in thickening of the peripheral and thinning of the central portions of the vertebrae; in a few instances there was a fine porous atrophy of the entire vertebral bodies. Roentgenographically the thickenings manifested themselves in increased opacities while the thinning and the fine porous atrophy appeared as rarefactions.

In the entire series there was only one case of osteitis fibrosa Recklinghausen, indicating that this condition must be very rare. The author describes in detail the changes of the spine in this case and establishes the following roentgenologic criteria as important for the differentiation from localized Paget's disease: The increased density extends not only to the marginal portions of the vertebra but to the entire vertebra, resulting in a loss of demarcation of the central and peripheral portions of the vertebral body. The picture is complicated by the presence of numerous areas of rarefaction irregularly scattered throughout the entire spine. The differentiation of osteitis fibrosa Recklinghausen from metastatic carcinosis of the spine (in carcinoma of the breast and prostate) is made on the basis that in metastatic carcinoma the bone changes which are both of the osteoblastic and osteoclastic type, are very irregular and of a moth-eaten appearance.—*T. Leucutia*.

LYON, ERNST. Das Verhalten der Bandscheiben bei typhöser Spondylitis. (The appearance of the intervertebral discs in typhoid spondylitis.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Oct., 1929, 40, 635-638.

From numerous roentgen examinations of cases of spondylitis typhosa, the author arrived at the conclusion that the condition produces marked inflammatory changes of the spine resulting in necrosis and new bone formation. There is a tendency to fast recovery and

marked regeneration. The intervertebral discs are often involved in the process.—*T. Leucutia*.

SCHMORL, GEORG. Über Knorpelknoten an der Hinterfläche der Wirbelbandscheiben. (Cartilaginous nodes on the posterior surface of the intervertebral discs.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Oct., 1929, 40, 629-634.

Three cases of cartilaginous nodes occurring on the posterior surface of the intervertebral discs are described. In the first case, that of a woman forty-eight years of age (who died from pneumonia), the cartilaginous node was at the posterior aspect of the 10th intervertebral disc, protruding 4 cm. into the spinal canal. In the second case, that of a man fifty-two years of age, the cartilaginous node was localized to the posterior surface of the 9th intervertebral disc and was 5 mm. high, 1.5 cm. long and 1 cm. wide. In the third case, that of a man fifty-one years of age, the cartilaginous node was on the posterior surface of the 7th dorsal intervertebral disc, protruding 5 mm. deep into the spinal canal.

Photographs and roentgenograms of the specimens are included.

The cases are presented in support of the theory that cartilaginous nodes are caused by proliferation of the nucleus pulposus following injury to the cartilaginous plates and are not the result of proliferation of remnants of the chorda as hitherto supposed.

Differential diagnosis includes spondylitis deformans and certain new-growths, especially osteochondroma.—*T. Leucutia*.

PIFFAULT and BARREAU. Radiographies du rachis. (Roentgenograms of the spine.) *Bull. et mém. Soc. de radiol. méd. de France*, Oct., 1929, 17, 252-253.

A case of rhizomelic spondylosis is described in a man fifty years of age. Roentgenograms in the anteroposterior view revealed marked opacity of the lower dorsal and lumbar intervertebral spaces, flattening and deformation of the lumbar vertebrae and sacralization of the fifth lumbar vertebra. There was ankylosis of the articulations with ossification of most of the small and especially of the yellow ligaments.

Roentgenograms in the lateral view revealed that the intervertebral spaces had a normal appearance and that the opacity which was

observed in the anteroposterior view was due to the calcified band bridging the intervertebral spaces on the anterior aspect of the spine.

The condition is exceedingly rare and belongs to the type of vertebral rheumatism described by Marie and Lévi.—*T. Leucutia*.

DELHERM and MOREL-KAHN. A propos des vertèbres d'ivoire. (Concerning ivory vertebrae.) *J. de radiol. et d'électrol.*, Nov., 1929, 13, 598-608.

Souques, Lafourcade and Terris in 1924 for the first time described a bone anomaly which consisted in an increased density with maintenance of the "morphologic integrity and homogeneous appearance" of one single vertebra and which they called ivory vertebra.

In reviewing the literature the authors found that only very few similar cases have been reported since. These cases (a total of 8) are briefly reviewed and discussed. In addition, the authors present 3 of their own cases and reproduce their roentgenograms. In the first case there was involvement of the fourth lumbar vertebra without definite etiology although a malignant condition was suspected. In the second case the involvement extended likewise to the fourth lumbar vertebra and here the condition was the result of an old Pott's disease. In the third case the involvement extended to the tenth dorsal vertebra and no definite etiology could be demonstrated.

On the basis of a study of the cases presented the authors arrive at the conclusion that the roentgen appearance of ivory vertebrae is identical to that of the so-called marble bone disease, except that the ivory vertebrae as a rule are single while marble bone disease is an affection of the entire skeleton. Another criterion of differentiation is that ivory vertebrae always occur in adults and old age while the marble bone disease is an affection of youth.

Pathologically the conditions are distinct entities. Whereas marble bone disease is the result of a generalized systemic disturbance associated with frequent modifications of the blood formula, ivory vertebrae may occur as the result of cancer, tuberculosis syphilis, lymphogranulomatosis, etc. Further observations are necessary in order to completely elucidate this rather interesting problem.—*T. Leucutia*.

GALLAND, MARCEL, and de LAS CASAS, HERMAN. La dynamique lombo-sacrée. Étude pratique de radiologie technique et clinique (le mal de Pott lombo-sacré). (Lumbosacral dynamics. A practical study of the technical and clinical radiology (lumbosacral Pott's disease).) *J. de radiol. et d'électrol.*, Oct., 1929, 13, 529-547.

The so-called "low back pain" may be the result of sciatica, funiculitis, lumbalgia, rheumatism, Pott's disease, congenital malformations, static disturbances, etc.

The authors made a detailed study (1) of the normal roentgen appearance; (2) of the morphology and normal mechanism, and (3) of the clinical roentgenology of the lumbosacral region.

(1) Normal roentgen appearance. The technique of the roentgen examination of the lumbosacral region in the lateral view is now well known and its value generally recognized. In the anteroposterior view, special procedures are necessary according to whether a demonstration of the body or of the arch of the fifth lumbar vertebra is required.

The elementary principle of a good roentgenogram of the spine is that the incidence of the rays must be as near as possible to the center of the curvature of the particular portion of the spine to be examined. For the mid-portions of the cervical and thoracic spines this incidence must be anteroposterior, while for the lower segments of the cervical and upper segments of the thoracic as well as for the entire lumbar spine and sacrum it must be postero-anterior. In scoliosis the rays should be directed towards the concavity of the curvature.

For the roentgen demonstration of the body of the fifth lumbar vertebra the patient is placed in abdominal decubitus and the tube is centered over the lumbar curvature, the central ray passing through the second lumbar vertebra. In this manner the fifth lumbar vertebra is roentgenographed tangentially, with very little distortion on the film. If the patient is too fat one has to resort to another procedure. A line is drawn (on the skin) between the inferior border of the anterior iliac crest and the interspinous space of the fourth and fifth lumbar vertebrae and the central ray is directed in the direction of this line with the patient either lying on the abdomen or on the back (with flexed knees), or being in a sitting position.

For the roentgen demonstration of the arch of the fifth lumbar vertebra the patient is placed on the back and the central ray is directed over the umbilicus. Here, too, the fifth lumbar vertebra is roentgenographed tangentially and while there is a marked distortion of the body of the vertebra the arch is very well visualized.

(2) Normal morphology and dynamics of the lumbosacral region. The fifth lumbar vertebra may be of the cuboid or infantile (in 32 per cent of the cases) and of the cuneiform or adult type (in 68 per cent of the cases). The lower surface of the vertebral body and the upper surface of the sacrum (the so-called lumbosacral disc) normally show an angulation of  $20^\circ$ . In standing position this increases to  $35^\circ$ .

The weight of the spine is transmitted from one vertebra to the other through the elastic nucleus pulposus which serves the purpose of mechanical ball bearings. The arches counterbalance the anteroposterior and lateral glidings of the bodies of the opposite vertebrae. The transmission of the weight from the spine to the pelvis and thus to the lower extremities is more complicated. Here the oblique position of the sacrum and the lumbar lordosis are the result of the progressive adaptation of the human to the biped posture.

(3) Clinical radiology. If the nucleus pulposus is partially or totally destroyed as, for example, in Pott's disease, the intervertebral disc collapses and a narrowing of the intervertebral space results. At the beginning the arches will try to correct this deformity but later muscular contractures intervene and a marked kyphosis with deformity of the spine ensues.

The authors also discuss the dynamics of the sacralization of the fifth lumbar vertebra and lumbarization of the first sacral segment, as well as the part certain new bone deposits play in the disturbance of the normal function of the lumbosacral spine (as in some cases of Pott's disease and in rheumatism).

Not infrequently, static troubles (deformity of the fifth lumbar vertebra, lumbar hyperlordosis and sacroiliac fatigue) are the cause of the low backache without there being any dynamic disturbance of the spine. This is important from the point of view of differential diagnosis.

The article is illustrated with numerous diagrams and schematic drawings.—*T. Leucutia.*

LAMY and LEPENNETIER. Malformation vertébrale post-traumatique d'aspect ostéomalacique. Osteopoécilia vertébrale? (Post-traumatic vertebral malformation giving the appearance of osteomalacia. Vertebral osteopoecilia?) *Bull. et mém. Soc. de radiol. méd. de France*, Nov., 1929, 17, 268-269.

A peculiar malformation of the first lumbar vertebra was observed by the authors in a girl twenty-three years of age who first appeared for examination in November, 1927, following a fall. The roentgen films at that time revealed an irregular decalcification with a flaky appearance of the first lumbar vertebra. It was evident from the examination that the condition had nothing to do with the trauma but that it represented a form of osteomalacia. The patient was immobilized by means of a plaster cast for a period of two years and subsequent roentgenograms failed to reveal any evidence of improvement in the bony condition although clinically all symptoms disappeared. No accurate diagnosis can be made, but the authors are of the opinion that the condition is either that of ivory vertebra or an atypical tuberculosis.—*T. Leucutia.*

KREUZ, LOTHAR. Ungewöhnliche Veränderungen an den Hüftkopfeiphysen einer Jugendlichen. (Unusual alterations of the epiphyses of the femoral heads in a child.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Dec., 1929, 40, 1034-1041.

An unusual alteration of the heads of the femur and their epiphyses is described in a girl eleven years of age who was observed by the author for a period of three years. At the beginning the condition showed a similarity to Perthes' disease but later, on account of the peculiar roentgen appearance and especially because of the lack of involvement of the femoral necks, it was classified as osteochondroarthropathia juvenilis.

The process occurred bilaterally and contrary to Perthes' disease it consisted chiefly in an oval destruction of the head of the femur with involvement of the epiphyses. During the period of two and a half years the lesion has extended only to the epiphyses and has failed to produce any changes in the femoral necks. No histologic examination was made and consequently nothing is offered in the way of



explanation of the etiology of the disease.  
—*T. Leucutia*.

NICHITA, M. I. Diagnosticul si tratamentul precoce in luxația congenitală a soldului. (Diagnosis and early treatment of congenital dislocation of the hip.) *Clujul med.*, Dec., 1929, 10, 630-634.

After describing in detail the early clinical signs of congenital dislocation of the hip the author emphasizes the following three roentgen signs: (1) obliquity of the cotyloid crest; (2) upward and outward displacement of the femoral epiphysis as compared to the center of the cotyloid cavity, and (3) hypoplasia and delayed development of the femoral head. The first sign, that is the obliquity of the cotyloid crest, appears very early and in several instances it was possible to make a diagnosis on this sign alone.

For the treatment of congenital dislocation of the hip the author advises the method of Putti which consists in the early immobilization by means of a triangular cushion which is applied for a period of at least six to eight months. A roentgen control at intervals of two to three months is advisable.—*T. Leucutia*.

SAUER, WALTER. Zur Pathogenese der Köhler'schen Erkrankung des Os naviculare tarsi. (The pathogenesis of Köhler's disease of the os naviculare tarsi.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Oct., 1929, 40, 679-685.

Five cases of Köhler's disease of the os naviculare tarsi are described. In none of the cases was there evidence of clinical symptoms and the condition was discovered accidentally at roentgen examinations. In connection with these cases, the etiology and pathogenesis of the disease is discussed and the opinion is expressed that Köhler's disease is the result of changes due to developmental disturbances. One of the cases observed by the author for a longer period presented in the first roentgenograms two ossification nuclei of the navicular bone. Later because of the reciprocal pressure of the bone developed by the two nuclei an atrophy of the entire bone resulted. This then proves that the condition is a developmental disturbance.—*T. Leucutia*.

#### BLOOD AND LYMPH SYSTEM

GRIFFITH, J. P. CROZER. Mikulicz's disease

and the Mikulicz syndrome. *Am. J. M. Sc.*, Dec., 1929, 178, 853-860.

Mikulicz's disease, as described by Mikulicz in 1888, is a chronic symmetrical enlargement of the lachrymal and salivary glands, beginning in the lachrymal glands and perhaps limited to them, but usually gradually extending. The swelling is hard, painless and apparently non-inflammatory. There is no disturbance of the lachrymal or salivary secretion, and the general health is not affected. Mikulicz emphasized the non-participation of the lymphatic glands in the process, and the lack of alteration of the blood. He could discover no cause for the condition, but believed it was an infection of some sort. Pathologic study of a portion of the lachrymal gland which had been removed revealed a widespread infiltration with round cells suggesting lymph-adenomatous tissue.

Enlargement of the lachrymal and salivary glands has been reported in association with other conditions such as leucemia, tuberculosis, syphilis, lymphosarcoma, toxic conditions, gout and the condition described by Heerfordt under the title of "febris uveoparotidea subchronica." Inasmuch as these conditions do not correspond in all respects to the original disease described by Mikulicz, they have been grouped under the title of "Mikulicz's syndrome."

The author reports 2 cases occurring in children one of which is a case of Mikulicz's disease proper while the other presents the Mikulicz syndrome having occurred in association with leucemia.

Writers on this subject have been much concerned with the possible tuberculous nature of the condition. Many pathological reports of the affected lachrymal glands have shown a histologic picture essentially that of tuberculosis yet in only 3 cases has it been possible to establish the diagnosis of tuberculosis unequivocally. In most of the cases it has been impossible to find the tubercle bacillus and inoculations in laboratory animals have given negative results. The author's first case regarded as Mikulicz's disease proper, gave a histologic appearance of tuberculosis in the excised lachrymal gland, yet such a diagnosis could not be substantiated by further investigations.

Mikulicz's disease and syndrome are uncommon, there being but 81 cases reported in

the literature. The treatment in the latter condition is the treatment of the primary disease. There is apparently no specific treatment for Mikulicz's disease proper. Roentgen and radium therapy have given good results in some cases. Surgical removal of the affected glands has been resorted to in relieving disfigurement and the interference with vision. Sometimes the swellings have disappeared during the occurrence of some general infection, to reappear later. Spontaneous cure has apparently been known to occur.—*Karl Kornblum.*

## GENERAL

EVANS, NEWTON, and BALL, HOWARD A. Coccidioidal granuloma. *J. Am. M. Ass.*, Dec. 14, 1929, 93, 1881-1885.

Fifty cases of coccidioidal granuloma which have occurred since 1916 at the Los Angeles County General Hospital were studied, and detailed statistics—clinical, pathological, bacteriological and roentgenological—are given.

Most cases occur between the ages of twenty and forty. Males predominate 41 to 9. Most patients have direct or indirect contact with the soil or with animals. Thirty-four per cent of cases give a history of respiratory infection preceding the initial external lesion. Duration of disease is from one to 62 1/2 months, averaging 9 1/4 months. Mild leucocytosis with a relatively low polymorphonuclear count is not uncommon. Most cases can be diagnosed during life by wet 10 per cent sodium hydroxide mounts and confirmed by cultures on Sabouraud's medium.

Roentgenographically the pulmonary lesion is a diffuse shadow simulating pneumonia. Often it is in the lower lobes. Late in the disease miliary distribution is common. Bone lesions are common, and peculiar sites of bone destruction in cases from regions where coccidioides infection exists should arouse suspicion.

Three main clinical types of the disease are

develops sufficient activity to cause a miliary pulmonary involvement.—*G. R. Miller.*

## ROENTGEN AND RADIUM THERAPY

KUHLMANN, B. Zur Prognose der Lymphogranulomatose. (The prognosis of lymphogranulomatosis.) *Strahlentherapie*, 1930, 35, 296-298.

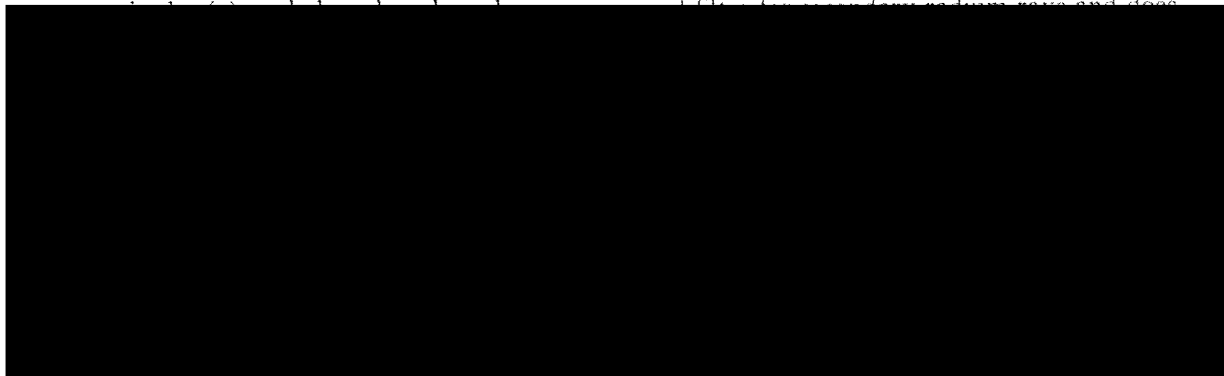
A case of lymphogranulomatosis occurring in a man twenty-two years of age who was treated by roentgen irradiation six and a half years ago is described in detail. At the time of the treatment the lesion extended chiefly to both parotid glands and the submaxillary and cervical lymph nodes. The diagnosis was confirmed microscopically.

The treatment consisted in the administration of 1/3 S.U.D. (0.5 mm. Cu and 1 mm. Al, 190 kv., 2 ma.) at intervals of six weeks for several series. The patient regained his normal health within a few months following the completion of the treatment and has remained well since.

The case is described since radiation therapy results only rarely in permanent healing of lymphogranulomatosis.—*T. Leucutia.*

ASTI, LUIGI MARIO. Note di tecnica per la costruzione di apparecchi in pasta Columbia nella Radiumterapia di superficie. (Technique of construction of apparatus of Columbia paste for superficial radium therapy.) *Radiol. med.*, Dec., 1929, 16, 1211-1273.

Columbia paste, which is made up of paraffin, wax and finely triturated saw-dust is superior in several respects to the substances which have been used before for applying radium to the surface of the body. When heated it is malleable and can be applied exactly to any surface to be covered; as it cools it hardens but is still malleable enough to adapt itself to the region of the body to which it has been applied. A particularly good property of this paste is that it is a



istered and for this purpose the author uses the ionomicrometer of Danne and Mallet.

He reports a series of experiments that he made to determine the best localization for the radium and the relations existing between the irradiating surface and the zones of maximum intensity.

He tries to determine the boundaries of these zones for different depths. The different forms of apparatus are divided into ones with plane surfaces, ones with curved surfaces and ones with mixed surfaces and the percentage depth doses for the different forms worked out. He gives illustrations of a series of such apparatus that he has used in the treatment of cancer and points out the most remarkable characteristics of each one.—*A. G. Morgan.*

HOPWOOD, F. L. The Radium Department of St. Bartholomew's Hospital, London. *Acta radiol.*, 1929, 10, 313-319.

The professor of physics gives an account of the organization and equipment of the radium department of the hospital. The total amount of radium element at the disposal of the Cancer Research Committee is at present 1100 mg., but will shortly be increased to 1600 mg. Of this 500 mg. are in solution and the remainder is distributed in several hundred platinum containers. The housing and equipment are described together with the radium emanation plant designed by Dr. René Ferroux. Various details of the equipment are illustrated. The general organization has already been described in the *British Journal of Radiology*, April, 1927, where full details of the rules enforced, the forms employed, etc., are given. The Radium Department on proper notice delivers radium to all hospital departments, collects it when unused or after use, keeps all containers in repair, keeps them in a safe custody when not in use and carries out routine tests and measurements. A daily census is kept of the number and location of all radium-salt containers, and complete records made of the number of hours of use, damages incurred and repairs effected. Similar records are kept of the production and employments of radon.—*A. G. Morgan.*

WALTER, E. Traitement radiothérapique d'un cas de calcification partielle de la capsule

articulaire de l'épaule. (Radiotherapeutic treatment in a case of partial calcification of the articular capsule of the shoulder.) *J. de radiol. et d'electrol.*, Nov., 1929, 13, 617-618.

A case of calcification of the joint capsule of the right shoulder is briefly described in a man forty years of age who for a period of two months had suffered from intensive pain. The administration of salicylates failed to influence the symptomatology. From April 24 to May 13, 1929, six irradiations were given to the region of the right shoulder with the following technique: 12 min., 29 cm. spark gap, 3 ma., 8 mm. Al, 25 cm. skin target distance, field 10 cm. in diameter, total dose 3000 R, a slight erythema having appeared following the fifth and a pronounced erythema following the last treatment.

All the symptoms rapidly disappeared following the roentgen irradiation and a second roentgenogram taken one month later showed that the calcification had entirely absorbed.

The case is interesting since it proves that recent calcifications can be made to disappear by means of roentgen irradiation. Nothing is known with regard to the etiology of the calcification in this case.—*T. Leucutia.*

ROTH, M., and STEINER, E. Radioterapie afectiunilor inflamatorii acute. (Radiotherapy of acute inflammatory infections.) *Clujul med.*, Dec., 1929, 10, 597-599.

The authors have used mild doses ( $1/10$  to  $1/2$  S.U.D.) of superficial roentgen rays for the treatment of acute and subacute infections for a period of over three years. Satisfactory results were obtained in 74 per cent of the cases treated.

The opinion is expressed that the results are the better the sooner the treatment is instituted. In many cases the temperature dropped within ten to twelve hours following the irradiation and in others terminated by lysis within two to four days. During the same time there was a rapid amelioration in the general condition of the patient.

The roentgen treatment has proved of considerable value in the following conditions: phlegmon, carbuncle, furuncle, hydrosadenitis, paronychia, pyoderma, mastitis, etc. Twelve rather unusual cases are described briefly.—*T. Leucutia.*

BRUNER, EDWARD. A propos du traitement des maladies de la peau par les rayons "limites" de Bucky. (Concerning the treatment of skin diseases with Bucky borderline rays.) *J. de radiol. et d'électrol.*, Nov., 1929, 13, 612-615.

Two hundred cases of various skin conditions were treated by the author and the conclusion is reached that the application of the borderline rays adds nothing to the usual methods of roentgen irradiation. The sole indication for the borderline rays is in connection with superficial lesions of the scrotum and eyelids. Furthermore borderline rays in large doses may produce severe ulcerations. Two such instances were observed by the author and photographs of these ulcerations are reproduced.

Comparative experimental investigations of the action of roentgen rays, borderline rays and ultraviolet rays on orthonitrobenzaldehyde solution and on leucocytosis revealed that there is no difference between the biologic action of the borderline and of the roentgen rays.—*T. Leucutia*.

BRAUER, A. Ueber Rationalisierung im Röntgenbetrieb des Dermatologen. (On standardization of roentgen procedures in dermatology.) *Strahlentherapie*, 1930, 35, 259-264.

Since 1921 the author has used the hot cathode Coolidge tube for the roentgen treatment of various skin conditions. This necessitated the adaptation of the old Meyer table (which the author formerly used for gas tubes) to the new conditions. The figures illustrating the relation of the dose (expressed in X) to the various skin target distances are included.

The author found that by using a great focus skin target distance (of 44 cm.) a 30 per cent Sabouraud dose can be administered with 2.5 ma. current in the rather short time of 2 minutes. This results in great economy of time, and it enables the roentgen therapist to cover, especially in the generalized skin lesions, larger areas at one time.

The author describes in detail, with illustrations, a new tube stand which is built into the wall and which permits a very great flexibility for all angles and directions.—*T. Leucutia*.

HOFFMAN, J. M. Radium in the treatment of diseases with subcutaneous or mucous mem-

brane hemorrhages. *Radiology*, Feb., 1930, 14, 136-138.

Five cases are reported, comprising two of umbilical hemorrhage, two of purpura hemorrhagica and one of hemorrhage after circumcision, in all of which radium treatment of the spleen was given. Save in one of the cases of umbilical hemorrhage, bleeding was stopped, and in both cases of purpura hemorrhagica the disease has not recurred. The author concludes that radium offers a new and valuable aid in the treatment of hemorrhagic diseases of the newborn, as well as in simple purpura hemorrhagica. In hemophilia radium will help in controlling the severe hemorrhages without other medication. He warns that if the total erythrocyte count is below 1,000,000 this method must be used very cautiously because of the hemolytic action of gamma rays, and preliminary transfusions should be given to bring the blood count above that level.—*J. D. Camp*.

REMER, JOHN, and BELDEN, WEBSTER W. X-ray diagnosis and therapy of thyroid disease. *Radiology*, Feb. 1930, 14, 145-150.

The roentgen ray, properly applied, is a safe therapeutic agent, according to these authors. Certain cases of toxic goiter should be given the benefit of irradiation for at least four treatments, continuing it if improvement is noted, and referring the case to surgery if no improvement occurs. Irradiation does not increase the difficulty of subsequent operation. Irradiation before operation renders a patient a better surgical risk. The danger of hypothyroidism is negligible. The basal metabolism test is an important adjunct and the treatment should be governed by it. Severe cases should be hospitalized and a period of rest obtained before treatment is begun and after the first one or two exposures.—*J. D. Camp*.

HOLZKNECHT, G. The roentgen treatment of morbus basedowii. *Radiology*, Feb., 1930, 14, 139-144.

The author points out that since 1904 it has been known that morbus basedowii can be cured by roentgen treatment, about 60 per cent of cases showing cure and about 20 per cent improvement to a greater or less degree. He concedes that a very acute case of the disease



should be operated on because of the quick relief which ensues. Cases not responding to roentgen therapy and those with signs of tracheal compression by a large nodular struma should also be operated on. But there is no reason at all for giving up local treatment of the thyroid and there is no basis whatsoever for resorting to general skin treatment with borderline rays, as advocated in certain quarters. As to the rays producing adhesions which render subsequent operation difficult, statistics prove that adhesions, if found, were already there before treatment, and that they occur just as often in untreated as in treated cases.—*J. D. Camp.*

SOILAND, ALBERT. The present status of roentgen ray therapy in breast malignancy. *Radiology*, Nov. 1929, 13, 388-391.

The author states that postoperative roentgen irradiation has been of tremendous value in diminishing pain, in destroying certain metastatic invasion, and in prolonging life; but the actual clinical cures, in the face of extensive metastasis, are few in number. He believes that preoperative irradiation has distinct value, especially if employed along the present lines of knowledge of radiation technique. It is reasonable to expect that roentgen rays in proper dosage can be valuable in inhibiting or destroying a pre-existing and as yet unoperated upon involvement. They should more readily destroy or inhibit the very early invading malignant cells, some of which are no doubt not even suspected or their presence accounted for by any demonstrable method of examination, so that they naturally escape surgical removal. He is convinced that in the cases in which adequate preoperative treatment can be carried out to a satisfactory conclusion recurrences are the exception and not the rule.

In his own clinic routine postoperative radiation treatment has been carried on for twenty years, and a certain amount of benefit has followed this procedure. No instances have been observed in which such treatment has augmented the disease or hastened its progress. In some advanced clinics the radio knife or electric scalpel is taking the place of the cold knife in resections of breast tumors, and it seems that this type of surgery has advantages over the ordinary scalpel in that a certain

amount of sterilization follows the path of the instrument, and there is less hemorrhage and consequently less danger of knife implantation of degenerated cells.

It is the author's plan to employ preoperative irradiation on a larger scale, keeping as careful records as possible, so that the method may be more definitely evaluated.—*J. D. Camp.*

EVANS, WILLIAM A., and LEUCUTIA, T. The roentgen-ray treatment of intrathoracic tumors. *Am. Rev. Tuberc.*, Jan., 1930, 21, 70-76.

In irradiation a tumor for therapeutic purposes, two factors have to be taken into consideration: (1) the primary response of the tumor to radiation, and (2) the reaction of the neighboring tissues influencing the irradiated tumor. While the first factor is concerned chiefly with the radiosensitivity of the individual tumor, the second depends on the particular structure of the normal tissues surrounding the tumor. In the roentgen therapy of intrathoracic tumors, both factors are of paramount importance.

The knowledge of the response of the tumor and its surrounding structures to radiation is important also, because it often serves as a basis of differentiation in cases in which a diagnosis by other means is impossible.

In order of their radiosensitivity, one may place, for practical purposes, the intrathoracic tumors in the following four main groups:

(1) Lymphoblastomata (lymphosarcoma, thymoma, pseudoleucemia, chronic lymphatic leukemia, etc.)

(2) Cellular anaplastic tumors (spindle-cell sarcoma and its varieties, teratoma, hypernephroma, Ewing's tumor, mediastinal Hodgkin's disease, etc.).

(3) Carcinoma, primary (chiefly of bronchogenic origin and, in rarer cases, of pleural, thymic and thyroid origin) and secondary.

(4) Benign tumors, dermoid cysts, pseudotumors (aneurysm, encysted pleural effusion simulating tumor).

In lymphoblastomata the largest bulky tumor masses entirely disappear within eight or ten days following irradiation. This rapid disappearance which is often called "melting away" is so typical that one can safely say that an intrathoracic tumor which has not entirely disappeared within ten days following irradiation

tion is not a lymphocytic cell proliferative process.

In cellular anaplastic tumors there is, as a rule, reduction to half of the original size within three to six weeks, and an entire disappearance within two to three months following irradiation.

In carcinoma, in the early cases, the repeated application of deep roentgen therapy and the local use of radium occasionally leads to healing; in the advanced, bulky tumors, however, a temporary reduction in size is all that can be expected. The aim should be rather to produce a fibrosis of the part of the lung involved than to act on the carcinoma tissue itself.

In benign tumors, dermoid cysts, and pseudo-tumors the response to irradiation is nil.

Since the variation in the rate of response of the above four groups is within rather broad limits, it is advisable that check-up films be taken within ten days, six weeks, and, after this, every two months following the irradiation and that these be compared with the original films taken prior to treatment. Such a procedure, in addition to the information it gives with regard to the results of treatment, also serves as confirmation or disproof of the diagnosis previously established.

Method of Treatment. (1) If the tumor is confined to the mediastinum, a dose of from 110 to 130 per cent S.U.D. is administered. The cross-firing is done through anterior and posterior oblique portals of entry, with the patient lying semilaterally, at an angulation of  $45^{\circ}$ . Whenever possible, the periphery of the lungs is excluded from the radiation, that is, no direct lateral ports of entry are used.

(2) If the tumor is localized in both lungs, as in the majority of metastatic tumors by the hematogenous way, a dose of from 110 to 130 per cent S.U.D. is administered over both lungs.

(3) If the tumor is localized in only one lung or parts of the lung, as in the majority of primary neoplasms of the lung, and in some secondary tumors (especially carcinomata) a dose of 130 per cent S.U.D. is given over the site of the lesion. Since in these cases the production of fibrosis is to be desired, treatment can be safely repeated with rather large doses.

The factors used are as follows: 200,000 volts (peak), 1 mm. copper, 1 mm. aluminum as filters (efficient wave length  $0.14\text{\AA}$ ), 70 to

80 cm. skin-target distance, large portals of entry, water-cooled tube, 100 per cent S.U.D. (on the surface of the skin) equalling 650 r.

The application of intravenous injections of colloidal lead in malignant tumors is comparatively recent. It is too early, therefore, to draw definite conclusions, but it appears that a combination of colloidal lead and roentgen-ray therapy is of noteworthy consideration.—*Authors' abstract.*

LANGERON, L., and DESPLATS, R. La radiothérapie de la région surrénale; médication vaso-motrice. (Radiotherapy of the region of the suprarenals; vasomotoric medication.) *Presse méd.*, Jan. 11, 1930, 38, 49-50.

The authors previously published their results obtained by the irradiation of the region of the suprarenals in certain forms of arterial hypertension, trophic and painful phenomena due to arteritis obliterans and certain paroxysmal vasomotor disturbances without arterial obliteration. In the present article they analyze the effect of the irradiation from the standpoint of vasomotor function.

1. Vasomotor results of roentgen therapy of the region of the suprarenals. These are purely clinical and to a large extent subjective. They consist (a) in a sensation of heat which appears very shortly after the roentgen therapy, no doubt due to increased capillary circulation; (b) in the cessation of pain which occurs soon after the treatment and which is often of a permanent nature (longest observation one year); (c) in the not infrequent amelioration of the intermittent claudication; (d) in the disappearance of erythromelalgic phenomena, and (f) in occasional improvement of trophic disturbances.

2. The action of roentgen therapy of the region of the suprarenals. Since the authors were unable to detect histological changes in the suprarenal glands removed following the irradiation, the effect of the roentgen rays must be through the sympathetic system. In this respect the suprarenals must form a connecting link with the sympathetic system as a whole.

3. Interpretation of results and mechanism of the action of roentgen therapy of the region of the suprarenals. The action of the roentgen rays on the sympathetic system consists chiefly in the reestablishment of the normal function

of the disturbed vasomotor reflexes. In this respect roentgen therapy differs considerably from sympathetic surgery which, as a result of the removal of sympathetic nerve fibers, leads to a permanent vasodilatation, while roentgen therapy reestablishes the equilibrium of the vasomotors without interrupting any of the sympathetic paths.—*T. Leucutia*.

GAUDUCHEAU, R. Curiethérapie des cancers inopérable du rectum par la méthode de Neumann et Coryn. (Curie therapy in inoperable cancers of the rectum with the method of Neumann and Coryn.) *J. de radiol. et d'électrol.*, Nov., 1929, 13, 609-611.

Thirteen cases (9 men and 4 women) of inoperable carcinoma of the rectum have been treated since 1926 by the author according to the method of Neumann and Coryn which consists of the following three stages: (1) permanent colostomy; (2) curie puncture of the tumor by the anal coccygeal route, and (3) en bloc removal of the neoplasm and sclerosed rectum. An interval of eight days is allowed between the first and second stage and of six weeks to three months between the second and third stage.

In the author's cases only the first and second stages were performed. The immediate results were satisfactory, but it is too soon to express an opinion with regard to the final outcome.

The inconveniences of the method are: (1) possible hemorrhages shortly following the removal of the radium needles; (2) very slow healing of the anal coccygeal wound, sometimes lasting for a period of nearly a year, and (3) the appearance of very severe pain within one year following the radium needling (and lasting for a period of many months) due to the sclerosis brought about by the application of the radium. For this reason the removal of the tumor remnants and of the sclerosed rectum as practised by Neumann and Coryn appears indicated.

The method is of value only in the carcinoma involving the ampulla recti.—*T. Leucutia*.

DEL BUONO, P. Contributo radiologico alla patogenesi e terapia delle metrorragie essenziali giovanili. (Pathogenesis and roentgen treatment of essential metrorrhagia in young subjects.) *Radiol. med.*, Dec., 1929, 16, 1191-1210.

Though the exact mechanism of the action of roentgen rays on the vegetative nerves has not been demonstrated, clinical experience and a great deal of experimental work have shown that small doses of rays do act on the nuclei from which the vegetative nerves originate, as shown by irradiation of the parhypophyseal region, on the cervical chain of the sympathetic, on the last dorsal vertebrae and the whole region of the pelvis and the genital system. Such irradiations may change the functional rhythm of certain organs or systems, as for example the sex glands, the skin, etc., if they have been changed as a result of primary disturbance of function of the glands of internal secretion or the conducting nerves of the vegetative system.

In the special case of excess of utero-ovarian function, that is, essential juvenile metrorrhagias, irradiation of the spleen, thyroid gland, the hypophyso-mesencephalic region and the uterus and ovaries sometimes gives satisfactory and permanent results if there is no primary organic disease of the uterus or ovaries. It is probable that any form of irradiation acts through the nerves of the vegetative system which controls the tonus of uterine and ovarian function. Irradiation of the nuclei or of the branches of the vegetative nervous system may modify the tonus of nerve conduction and establish equilibrium in the sympathetic-parasympathetic system or, as seems more probable, regulate endocrine-sympathetic correlation, as there are reasons for supposing that these functional disturbances are endocrine-sympathetic diseases.—*A. G. Morgan*.

#### MISCELLANEOUS

LACASSAGNE, A. The importance of filtration and superiority of pure gamma radiation in the radiotherapy of malignant tumors. *Radiology*, August, 1929, 13, 95-102.

The work of Dominici established, since 1907, for units of radium salts, the greatest efficacy against cancer cells, and the greatest harmlessness for normal tissues of the gamma radiation obtained with a minimum filtration of 0.5 mm. platinum. It has been established experimentally that unfiltered units of radon provoke around themselves a zone of diffuse necrosis of all the tissues; this zone becomes narrower the more one increases the filtration or decreases the intensity of the radiation;

beyond a certain thickness of platinum and for a definite intensity, radium necrosis may be completely eliminated. Radium necrosis is the cause of grave accidents, such as hemorrhage, paralysis, neuritis, bony sequestration, radium dermatitis, perforation and infection. It offers no compensating advantage. The author believes that the techniques of curie therapy with pure gamma radiation, which offer the same technical possibilities, and a greater efficacy in the treatment of cancer than techniques with composite radiation, should be preferred to them.—*J. D. Camp.*

COHN, MAX. Die körperliche Darstellung der Haut im Röntgenbild. (The stereoscopic visualization of the skin in roentgenograms.) *Chirurg*, 1929, 1, 784-787.

The author devised a plan for the roentgen stereoscopic visualization of the skin surface of different body parts so as to be able to more accurately estimate the depth from the surface of the skin of lesions or foreign bodies examined. This consists in the placement of landmarks on the two opposite surfaces (as, for example, a penny on the anterior and the letter R or L on the posterior surface) and the spiral winding of a special bronze coated adhesive around the part of the body to be examined.

Four pairs of stereoroentgenograms are presented in order to show the practical value of the method.—*T. Leucutia.*

STEPHANI, JACQUES. De l'emploi de l'anti-diffuseur pour les radiographies pulmonaires. (The use of the Bucky diaphragm in pulmonary roentgenograms.) *J. de radiol. et d'électrol.*, July, 1929, 13, 393-396.

By making use of the rotating Bucky diaphragm (of Åkerlund) the author was able to obtain good roentgenograms of the chest. It was found that if the distance was 1 meter 50 cm., the time of exposure had to be increased  $2\frac{1}{2}$  to 3 times above that without the use of the Bucky diaphragm. The images were superior to those obtained by any other method and they were of great diagnostic value, especially when the demonstration of structural details of the lungs was desired. In large pleural effusions there was no advantage in the use of the method.

If the regular Potter-Bucky diaphragm is used, an arrangement must be made to run the

grids of the diaphragm perpendicularly.—*T. Leucutia.*

BRAMS, JULIUS, and DARNBACHER, LEO. The effect of x-rays on the gall-bladder: experimental production of an x-ray cholecystitis. *Radiology*, August, 1929, 13, 103-108.

A definite acute and chronic cholecystitis was experimentally produced in a series of dogs with doses of roentgen rays that are within the range of those used for therapeutic purposes. The extent of the inflammatory process is dependent upon the dose and reaches a maximum after a period of twelve days. The changes vary from small, isolated petechial hemorrhages to a diffuse edema and an advanced, infiltrated fibrous cholecystitis. The changes are most marked in, and in a majority of cases are limited to, the fundus of the gall-bladder. Basing their opinion on the relative lack of injury to the exposed portion of the duodenal and pyloric mucosa, the authors believe that the gall-bladder epithelium is comparatively more sensitive to roentgen exposure than the other organs in apposition to it. The possibility of injury to the gall-bladder following deep therapy in the region of the right upper quadrant of the abdomen must be borne in mind.—*J. D. Camp.*

CASATI, A. Sulla presenza di "zone di azione" nei corpi irradiati come effetto dell'irradiazione con raggi X. ("Zones of action" in irradiated bodies.) *Radiol. med.*, Nov., 1929, 16, 1138-1144.

The author made a study of the action of roentgen rays on bone marrow and on solutions of 1 per cent sublimate. He found that the action of the rays was not uniformly distributed but that they acted on certain circumscribed and discontinuous zones of the irradiated body. He concluded that this distribution of the effect is connected with certain secondary phenomena of irradiation. The changes brought about are a resultant of various energies acting at the same point at the same time and reinforcing or annulling each other. Visible effects are produced only under certain conditions. Outside these conditions and with an amount of energy less than the threshold necessary, no visible effect is produced.—*A. G. Morgan.*



CANTI, R. G. Biological effects of radium irradiation. *Acta radiol.*, 1929, 10, 320-331.

The earlier observations on the histology of tumors irradiated with gamma radium rays are described. The difficulty in interpreting the results led Strangeways and his coworkers to study the effect of radiation on tissue cultures. The most important changes produced are: a cessation of mitosis, which is immediate; the return of mitosis in large numbers and abnormal forms in three to four days; disappearance of mitosis for the second time in eight or nine days; presence of cell debris which is removed by phagocytes; the replacement of the new growth by fibrous tissue; mummification which is rare and found in certain cases where the destroyed new-growth is not absorbed. It was comparatively easy to observe these changes but the mechanism by which they were brought about was not so evident.

The hypothesis of delayed lethal dose is considered. An experiment is described which gives a naked-eye demonstration of the effect of beta rays on a row of cress seeds. The time-intensity ratio is then considered and the results of experiments on tissue cultures show that there is a threshold of intensity and a threshold of time, each of which must be passed before radiation has any biological effect. A comparison of the time factors used in these experiments and by radiologists leads to the subject of indirect action, which is briefly discussed. The selectivity of action of gamma rays on cancer cells is illustrated by cuttings from cinematograph films of tissue cultures of normal cells and malignant cells from Jensen's rat sarcoma and a photograph is given demonstrating the selective action of beta rays on colon bacilli in an agar culture of streptococci and colon bacilli. Reference is made to stimulation in an experiment described on tissue cultures showing an increase in cell division which might erroneously be considered the result of stimulation.—*A. G. Morgan.*

BODE, H.-G., and RIECKE, E. Zur Histologie sensibilisierter roentgenbestrahlter Haut. (On the histology of sensitized roentgen irradiated skin.) *Strahlentherapie*, 1930, 35, 265-289.

The author sensitized the skin of guinea pigs and white rabbits with chrysarobin, iodine and croton oil (and in a few instances with injections

of salvarsan) and then exposed it to roentgen irradiation.

The hair of the animals was removed (in guinea pigs on the back and rabbits on the thighs) and two days later the bare areas were treated (twice daily, for three days) with the above substance. The roentgen irradiation was carried out with unfiltered roentgen rays (0.6 mm. half-value layer aluminum) in doses of 957 r, some of the animals being irradiated the third and others the fifth day following the sensitization.

Salvarsan sensitization was applied only to rabbits by injecting 0.275 gm. myosalvarsan per kilogram body weight intramuscularly at 10 A.M., and by irradiating the animal the same day at 6 P.M.

The irradiations were carried out in such a manner that half of the sensitized areas and an equal part of a normal (unsensitized) skin was included within the field of irradiation (so as to have control sections for the changes produced by either the irradiation or sensitization alone).

In none of the animals was there any evidence of macroscopic changes. Within eight days part of the skin from (a) only sensitized; (b) only irradiated, and (c) sensitized and irradiated areas was removed and examined microscopically.

It was found that roentgen irradiation of the sensitized skin resulted in increased structural changes as compared to the modifications brought about by either the sensitization or the irradiation alone. The structural changes were present both in the epidermis and subepithelial connective tissue. In the epidermis they consisted of liquefaction, edema, pycnosis, hyaline degeneration, etc., while in the subepithelial connective tissue they were characterized by destruction phenomena of a moderate degree. The changes were especially pronounced in the skin sensitized by salvarsan where there was also evidence of mild inflammation.—*T. Leucutia.*

HENRARD, E. Commotion électrique à 110 kilovolts, accident de laboratoire. (Electrical shock at 110 kv., laboratory accident.) *Bull. et mém. Soc. de radiol. méd. de France*, Nov., 1929, 17, 262-263.

The author describes a very unusual accident which occurred during the taking of a roentgenogram. For some reason the high tension

starter failed to function and the operator disconnected the tube to test the machine. After starting and stopping the machine several times the impression was gained that the high tension starter began to work and the operator proceeded to reconnect the tube. While touching the wire he got a heavy shock.

What most probably happened is that the starter (through fusion) established a permanent contact, thus sending the high tension current through the line, when the operator thought that no current was on.

It is recommended in connection with this: (1) that one should never try to connect or disconnect high tension tubes or the milliammeter while the machine is running; (2) that a red signal light be placed in the primary circuit of the transformer indicating when the high tension current is on, and (3) that an automatic device be provided with each apparatus, stopping the machine whenever there is an accidental contact with the high tension circuit.—*T. Leucutia*.

PFALZ, G. J. Die immunbiologische Bedeutung von Röntgenschwachbestrahlungen für die bactericide Kraft des Blutes. (The immunobiologic effect of mild roentgen irradiations on the bactericidal power of the blood.) *Arch. f. Gynäk.*, 1929, 138, 93-110.

As a result of previous experiments the author found that the nonspecific, specific and combined protein injections (novo-protein, yahren-casein, gono-yahren, autogenous gonococcus, streptococcus and staphylococcus vaccines) led to an increase in the bactericidal power of the blood, characterized by the following four phases: (1) an initial decrease (Weichardt) lasting for a period of a few hours (negative phase); (2) an acute increase occurring regularly within four to six hours following the injection; (3) a phase of exhaustion lasting from eight to twenty-four hours following the injection, and (4) a continuous gradual increase lasting for a period of several days.

In the present article the results of the experiments with mild doses of roentgen rays (as employed for the treatment of infections) are given. The microorganism used for the determination of the bactericidal power of the blood was the yellow hemolytic streptococcus and the method that of Wright.

The irradiation included 20 cases of acute

infections (180 kv., 4 ma., 40 cm. skin target distance, 10 by 15 cm. field, 0.8 mm. Cu, one abdominal and one dorsal field, 10 per cent s.u.d. at the site of infection), and 30 cases of preclimacteric metro- and menorrhagias (in which either a temporary castration dose of 25 to 28 per cent s.u.d., or a permanent castration dose of 36 to 38 per cent s.u.d. was administered by using identical factors).

It was found that in both instances in 71 per cent of the cases there was an increase of the bactericidal power of the blood as a result of the irradiation. The immuno-biologic phenomena were characterized by the same four phases as described for autogenous vaccines or protein reactions. From this the author concludes that since the end-effects of the protein injections and of the mild irradiations are the same the mechanism leading to them and the cause provoking them must also be the same. In other words, the effect of mild doses of roentgen rays must be through the activation of the protoplasm (Weichardt) which is the seat of all proteolytic and immuno-biologic processes.—*T. Leucutia*.

GLOCKER, R., and REUSS, A. Strahlenschutz-messungen. (Measurements in radiation protection.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, September, 1929, 40, 501-507.

1. Determination of the lead absorption coefficient. The recommendations of the Protection Committee of the Second International Congress give the following thicknesses of lead as essential for complete protection (between the voltages of 100 kv. and 200 kv.).

100 kv.	1.5 mm. lead
125	2.00
150	2.5
175	3.0
200	4.0

By investigating the absorption coefficient for the above values, the authors found that the lead absorption remains practically constant between 100 and 200 kv., and that consequently a specification of the lead thickness for 125, 150 and 175 kv. is unnecessary, or at least does not have a physical foundation.

2. The protection of a Metalix therapy tube was tested photographically and ionometrically. It was found that by running the tube at 200 kv. and 5 ma. one may approach the tube from all angles within a distance of 0.5 meter

without exceeding the dose considered as safe by Mutscheller.

3. The lateral scattered radiation emanating from the subject submitted to a roentgenologic examination is considerably greater than hitherto supposed. In experimenting with a water phantom of 20 by 20 by 20 cm. it was found that a voltage of 110 kv. leads at a distance of 50 cm. from the center of the phantom to a scattered radiation which is as large as that produced by a highly filtered therapy tube running at 220 kv. This exceeds the safe dose of Mutscheller by eight to twenty times, indicating the necessity for greater precautions in diagnostic roentgenoscopy.—*T. Leucutia*.

GUNSETT, A. L'évaluation en unités r électrostatiques et en unités R Solomon des réactions cutanées, avec quelques remarques sur la dépendance de la longueur d'onde du nombre d'r correspondant à une même réaction cutanée. (The evaluation of the cutaneous reactions in r (electrostatic) units and in R (Solomon) units, with some remarks on the dependence on the wave length of the number of r leading to the same cutaneous reaction.) *J. de radiol. et d'électrol.*, June, 1929, 13, 332-336.

The author emphasizes the inadvisability of too sudden a change from the R (Solomon) to the international r as adopted in Stockholm.

A dose of 550 r (field 48 sq. cm., 0.5 mm. Cu) produces, according to German investigators, an erythema of the skin appearing eight days following the irradiation and lasting for a period of three weeks, while 605 r leads to first degree, 660 r to second degree, and 715 r to third degree radiodermatitis. In transposing a dose of 3000 R which is used routinely at the Strasbourg Clinic into absolute units, it was found that this would correspond to 827 r, a dose which according to the above figures should produce a third degree radiodermatitis. A dose of 4500 R with 2 mm. Cu given in fractions over a period of four to five days, on the other hand, would correspond to 842 r applied in one single sitting. It appears that further investigations are necessary in order to elucidate this great discrepancy in the doses applied before resorting to their change into absolute units.—*T. Leucutia*.

GUEBEN, GEORGES. A propos des techniques de mesures des radiations pénétrantes. (Con-

cerning the technique of measurement of penetrating radiations.) *J. de radiol. et d'électrol.*, July, 1929, 13, 389-392.

The procedures of measuring penetrating radiations may be classed into two groups: (1) the measurement of the rate of charge of a conductor under the influence of the ionization current, and (2) the measurement of the rate of discharge of a conductor preliminarily charged and submitted to the action of the ionizing agent. The procedures of the first group, among them the method of Piccard, lead to practically no errors since the insulated conductor is charged to a very low potential and consequently the loss of charge is extremely small. The procedures of the second group make use of the ionization chamber which may be of the large chamber and of the thimble chamber type. In the large chambers the errors, whether the measurement is done galvanometrically or electrometrically, are likewise small, but in the thimble chambers they are often very great.

In analyzing the cause of the errors in thimble chambers the author found that they are due in no small part to the change in conductivity of the insulating materials (usually amber, or more recently ceresin, as for example in the dosimeter of Glasser and Seitz) used for the connection of the small ionization chambers to the cable leading to the measuring instrument.

Already in 1896, Thomson and McClelland observed that the conductivity of solid and liquid dielectrics increased following irradiation. Numerous investigations carried out since that time only served to confirm these observations. The author recently submitted ceresin (a very hard paraffin extract from ozocerite) to the action of the gamma rays of 83 mg-el. of radium and found that the conductivity increased within two to three hours following the irradiation 100 times, and that this increased conductivity did not die off until twenty-four hours following the cessation of the irradiation.

This, then, indicates that whenever a small ionization chamber, or the dosimeter of Glasser, is submitted to irradiation, an ionization current develops not only within the ionization chamber, but in the solid dielectric as well, leading to an error the value of which cannot be underestimated. Generally, the larger the field of irradiation and the greater the intensity

and penetration of the rays, the greater the error committed.—*T. Leucutia.*

STRAUSS, SIEGMUND. Das Grenzstrahl-Mekapion und weitere Verbesserungen am Röntgen-Mekapion. (Borderline-ray mecapion and further improvements in the roentgen mecapion.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Oct., 1929, 40, 655-659.

A new mecapion designed for the purpose of measuring the borderline rays of Bucky (in the neighborhood of 10 kv.) is described in detail. The ionization chamber is constructed, following recommendation, of goldbeater's skin and the clock arrangement is changed so that one signal interval corresponds to 15 r.

Changes were also made for the roentgen mecapion by constructing a new ionization chamber which is entirely independent of the hardness of the rays (between 120 and 200 kv.), and by providing the instrument with an automatic stop which is mounted on the roentgen ray machine.—*T. Leucutia.*

KÜSTNER, HANS. Die Rolle der grossen und der kleinen Ionisationskammer bei der Röntgenstrahlenmessung. (The rôle of the large and small ionization chamber in roentgen measurements.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Oct., 1929, 40, 603-628.

This article represents a summary of the basic principles of roentgen dosage measurements with both the large and small ionization chambers. The value of these chambers, their dependence on the hardness of the roentgen rays, the importance of saturation, the errors of measurements and their prevention in deep and superficial therapy, the standardization in absolute r, and the control with radium sources are discussed in detail. The conclusion is reached that large ionization chambers lead to more accurate results than small ionization chambers but that in practice where an absolute accuracy often is not required small ionization chambers are of greater advantage. They permit the actual measurement of the dose on the patient and they allow water phantom determinations which are impossible with the large ionization chambers.—*T. Leucutia.*

CHANTRAINE, H., and PROFITLICH, P. Künstliche Radiumstrahlen? (Artificial radium rays?) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Oct., 1929, 40, 659-664.

Every radium worker must gain the impression that the action of radium, especially on tumors, is superior to that of roentgen rays, due no doubt to the higher penetration of the radium rays.

This brings up the problem of the advisability of increasing the voltage in deep therapy apparatus. Several investigators found no difference in the action of the roentgen rays when increasing the voltage from 200 kv. to 240 kv., but in order to get rays as hard as those of the radium source one would have to increase the voltage to 1500 kv.

The authors experimentally irradiated a film placed perpendicularly in a water phantom by a radium source of 50 mg. element (23 cm. distance) and compared (with the aid of the densographic method) the effect on the photographic film at 10 cm. depth with that of deep roentgen rays. They found that in radium the amount of scattered radiation 3 cm. laterally from the beam of the rays was 24 per cent and 5 cm. laterally 18 per cent, while in the case of deep roentgen rays (200 kv., 0.5 mm. Zn, 6 by 8 cm. field, 23 cm. distance) the scattered radiation 3 cm. laterally from the radiation beam amounted to 30 per cent, and 5 cm. laterally to 22 per cent. This indicates that a great difference in the scattered radiation produced by the hardest roentgen rays and those used nowadays cannot be expected. Of course the discovery of some new effect (similar to the Compton effect) might entirely change the aspect of the problem, leading to practical results which cannot be computed on the basis of theoretical calculations.—*T. Leucutia.*

DAUVILLIER, A. Anwendung der Grundlagen des Fernsehens in der Röntgenologie: der "Radiophot." (The application of the principles of television in roentgenology; the "radiophot.") *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Oct., 1929, 40, 638-654.

As is known roentgenoscopic images lack brightness and they are greatly fogged by scattered radiation. They are neither apt for reduction in size nor for reproduction. Furthermore, the energy sources which are necessary for their production are harmful both to the patient and to the examining roentgenologist.

In order to overcome the above disadvantages, the author in 1915 for the first time tried to apply the principle of television for



roentgenoscopic examinations, by making use of the double disc of Nipkow. The apparatus so constructed was called the "radiophot." It consisted of a rotating disc which served for the analysis and synthesis of the image, the disc containing small holes spirally arranged at definite distances. The holes serving for the analysis of the image were covered with black paper and the ones serving for the synthesis with stoppers of lead glass. The disc also contained spirally arranged crystal lenses for the amplification of the light intensity of the image to 100.

The disc which is placed between the roentgen source and the object to be examined is rotated during the time of the examination so that parts of the object are thrown by the roentgen bundles coming through the analytic holes on a large ionization chamber (specially constructed so as to deliver a maximum ionization) serving the purpose of a detector. The ionization current which is amplified is connected to a light source illuminating the "synthetic" holes. In case of individual observation a neon lamp which is placed in the focus of the condensor is used, while in case of demonstration to a large audience, the image is projected with the aid of the Kerr system.

The different parts of the apparatus such as the ionization chamber (which must yield the greatest amount of ionization possible and which therefore is made of metal walls and filled with either argon or krypton gas), the amplifier, the light source and the Kerr system for projection, as well as the changes necessary in the construction of the roentgen source, are discussed in lengthy detail.

More recently new improvements have been added to the apparatus, making its use more practical. Thus the disc which divided the image at the beginning into 100 elements, was provided with a new arrangement of the holes permitting a division into 900, and more

recently into 3600 elements. It is hoped that in this manner a satisfactory examination of a larger portion of the body can be obtained.

The advantages of the apparatus are that the images, because of their transmission into fractions of elements, are entirely free of the effects of scattered radiation and fogging, that they can be reduced to any size, that they can be projected to any place, and that they can be photographed cinematographically. At the same time there is a maximum protection to both the patient and the roentgenologist.—*T. Leucutia.*

BRAUN, R., AND KÜSTNER, H. Zur Physik der Fingerhutkammer. III. Die Genauigkeit der Absolutbestimmung der Röntgeneinheit mit Fingerhutkammer und Fasskammer. (The physics of the small thimble ionization chamber. III. The accuracy of the absolute determination of the roentgen unit with the thimble chamber and large air chamber.) *Strahlentherapie*, 1929, 33, 273-295.

In a very careful theoretical and experimental study of Fricke and Glasser's proposed use of a small air wall chamber in the determination of the absolute r-unit, the authors arrive at the conclusion that the error in measuring the "r" with this method is considerably larger (+ 6.3 per cent) than when using the large air chamber apparatus ( $\pm 1.5$  per cent). In these experiments ten small ionization chambers of different construction were used with various qualities of radiation. The largest error is caused by the difficulty of accurately measuring the volume of the small chambers and also by the difficulty of correctly interpreting the dependence of the electron emission of the air wall upon the radiation quality. All small chambers must be calibrated by means of a large air chamber, and therefore the latter should be given the preference over the small chamber method in determining the r-unit.—*O. Glasser.*



# THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. XXIV

AUGUST, 1930

No. 2

## A ROENTGENOLOGIC STUDY OF THE BREAST\*

By STAFFORD L. WARREN, M.D.

ROCHESTER, NEW YORK

WE WISH to present a simple method of studying the breast by means of stereoscopic roentgenograms. This technique has been in use for practically three years at the Strong Memorial Hospital and about 100 cases have been studied. We believe that this method will be absolutely diagnostic in some types of cases and of considerable assistance in others. It has a very definite limit in certain instances. This limitation will be described in detail. Cutler† recently described a transillumination technique for the study of pathological conditions in the breast. Transillumination of the breast is essentially similar to soft tissue roentgenograms. Roentgenograms, however, have the additional advantage of a stereoscopic technique and permanent record.

### TECHNIQUE

The technique is simple. A Potter-Bucky diaphragm gives the best results, but it is not absolutely necessary. The patient is placed obliquely, say upon her right side with the right arm elevated above the head which rests upon it. The axilla and pectoral muscles are thus stretched upward and outward. The right breast should then be centered upon the

Potter-Bucky diaphragm so that its greatest thickness will be silhouetted upon the film. This can be adjusted somewhat by having the patient pull upon the skin of the chest with the tips of the fingers. In patients having large breasts, the left breast is pulled back and upward out of the way by the patient (using her left hand). A sand bag is placed under the left shoulder

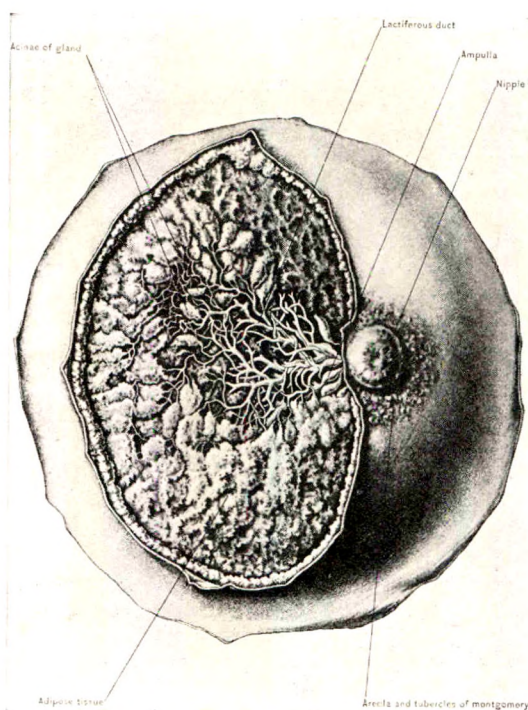


FIG. 1. Drawing of the breast showing gross details. (From Deaver and McFarland, "The Breast," Blakiston's Son & Co., 1917.)

\* From the Department of Radiology, Strong Memorial Hospital, Rochester, N. Y. Read at the Thirtieth Annual Meeting, American Roentgen Ray Society, New York City, Sept. 17-20, 1929.

† Cutler, M. Transillumination as aid in diagnosis of breast lesions, with special reference to its value in cases of bleeding nipple. *Surg., Gynec. & Obst.*, 1929, 48, 721-729.



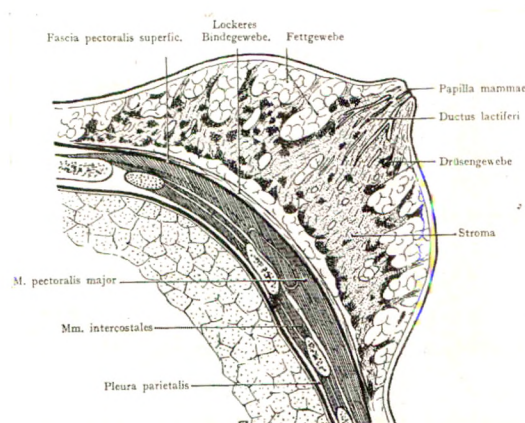


Fig. 200. Sagittalschnitt durch die weibliche Brustdrüse.

FIG. 2. Drawing from Corning's "Anatomy" showing sagittal section of the breast.

to enable the patient to retain her position.

The tube is centered over the middle of the breast or over the suspected area if it is large. A pair of stereoscopic films are made in the usual manner. The shift is usually up

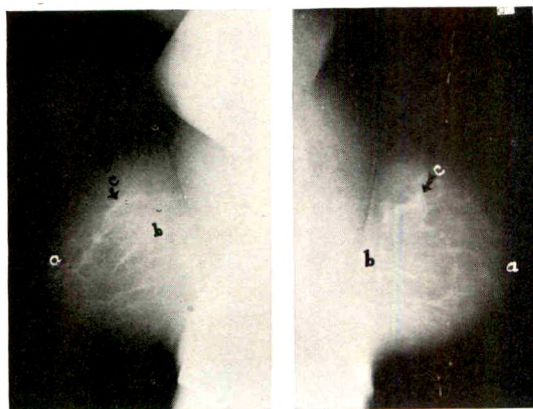


FIG. 3. Simple obesity. Note the ducts (a) and acini (b). There are several small masses due to chronic mastitis in each breast (c).

and down, though a cross shift is occasionally made, depending upon the type of case.

The factors are: 70 ma. and  $2\frac{1}{2}$  seconds, or 185 ma-sec., 25 inch target-film distance, 50 to 60 kv., double screens,  $10'' \times 12''$  Eastman superspeed film, Potter-Bucky diaphragm.

The opposite side is always taken for comparative study. This is very important.

Mr. William T. Hill, our head technician,

is responsible for the simplification and standardization of this technique.

#### INTERPRETATION OF THE NORMAL BREAST

When the films are viewed stereoscopically (preferably with both breasts shown side by side), the normal breast structures can be fairly clearly seen. The nipple usually stands out from the areola. The ducts, usually numbering from five to eight, extend downward toward the base. The base is sharply separated from the pecto-

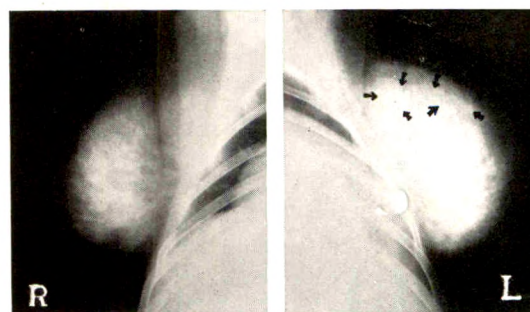


FIG. 4. Obese lactating breast with acute mastitis and abscesses in the outer upper quadrant of the left breast.

ralis muscles by a definite line or septum about 1 mm. in thickness. The acini masses or lobules of the breast stand out from the fatty masses which are usually transparent. The lobules frequently extend upward toward the axilla to make what is called the tail of the breast.

The pectoralis muscles are usually seen as a layer from 1 to 3 cm. thick beneath the base of the breast. There is a thin septum

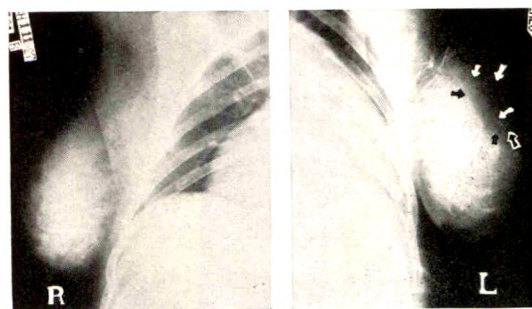


FIG. 5. Same patient as Figure 4, showing change in the left breast after incision and drainage of the abscess in the outer upper quadrant.



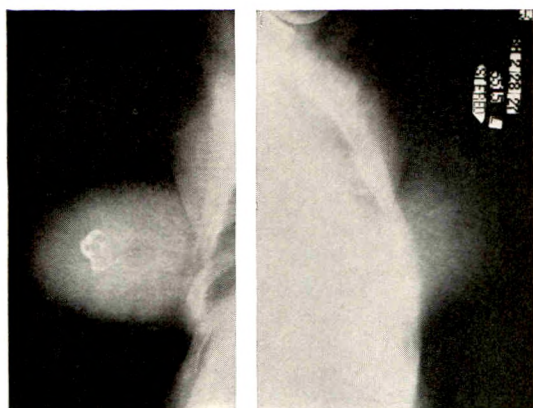


FIG. 6. Right breast showing intracanalicular myxoma with calcification in an old area of hemorrhage. Left breast: chronic mastitis. The details are difficult to see in the reproduction.

between them and the ribs and intercostal muscles. Often the pleura can be identified as a faint line.

In the axilla the nodes are not usually visible, but the blood vessels and muscles stand out clearly. The axillary hair if thick, and especially if dirty, may stand out distinctly.

This normal state varies all the way from the flat discoid breast, where the structures are very compact, to the huge obese breast where they are spread apart by the masses of fat.

#### CHANGES DUE TO PREGNANCY

In the fifth and sixth months of pregnancy the films show a definite enlarge-

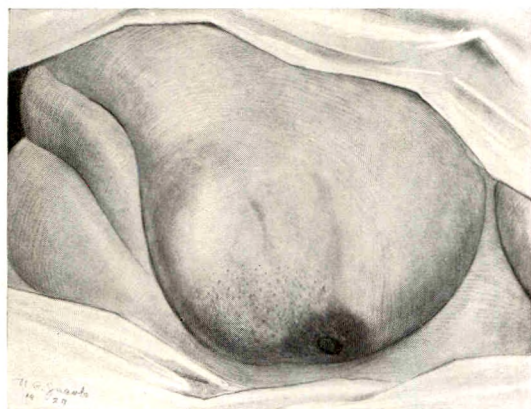


FIG. 7. Drawing showing the clinical appearance of the breast in Figure 6.

ment of the whole breast. This involves the fatty masses and the lobules. The ducts become denser, and the breast (previously slightly flabby) seems tenser and more rounded. This process becomes more marked as time goes on. Just at term, and especially at the onset of labor, the breast is large, tense, and suffused with either edema or congested blood vessels. The appearance is not unlike chronic passive congestion of the lungs with patches of

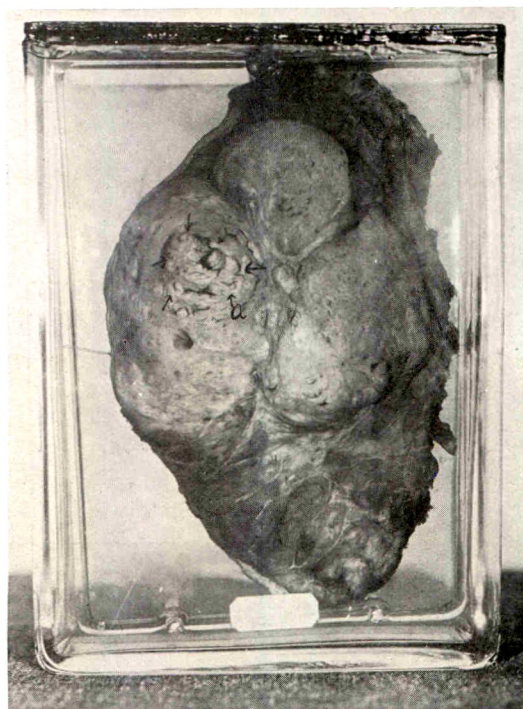


FIG. 8. Specimen of breast in Figures 6 and 7 showing the whorl formation and the lobulation which is visible in the roentgenogram. The circumscribed area of calcification (a) shows some central degeneration. Intracanalicular myxoma.

consolidation, the latter being represented by the dense, markedly enlarged breast lobules. At this stage the breast lobules become feathery at their margins.

After birth, and after lactation has commenced, for the first few days the breast structures are obscured by a rather diffuse haziness, and the dense lobules are indistinct in outline. At the end of a week this haziness has disappeared to a great extent.



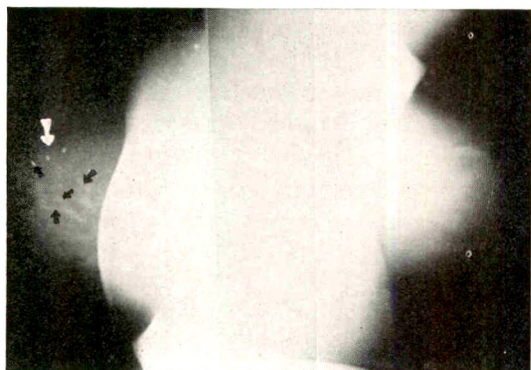


FIG. 9. Clinical diagnosis—papillary cystadenoma. Three radium seeds are visible in the residual framework of the tumor. The ducts nearby are all thickened and probably involved by the tumor process.

The lobules are still large and dense and have feathery outlines. They tend to supplant the fat masses in the main portions of the breast. The ducts are large and dense, but they are uniform in caliber. The axillary nodes are often visible when lactation begins, and vary from 0.5 to 3 cm. in diameter.

#### BREAST ABSCESS

Four cases were examined. All of them were postpartum. In three, localization

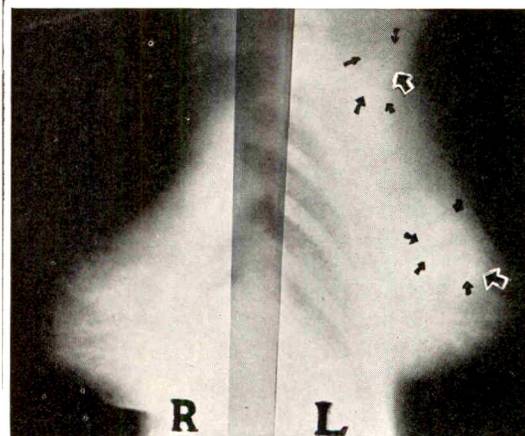
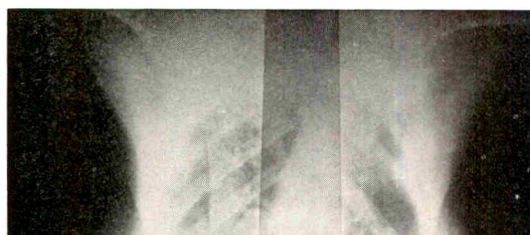


FIG. 11. Showing a large tumor mass (? medullary type of adenocarcinoma) in the upper outer quadrant of the left breast and axillary masses. Diffuse marked chronic mastitis in both breasts. (Cf. Fig. 10.)

was proved correct by incision and drainage. The fourth case was relieved by hot packs and pumping. The localization of the abscess, however, corresponded with the clinical evidence (redness, tension, and pain). In each case, the usual picture of lactation was present with the addition of considerably more of the general haziness than is usual at this stage. A more or less clearly outlined, uniformly dense mass,





about 2.5 cm. in diameter, could be made out in all three cases. This was not to be confused with overlapping lobules but was quite a distinct entity. In one case, there were two such masses, one in the upper outer quadrant and one in the lower inner quadrant of the right breast. Each yielded about 5 c.c. of purulent material at operation.

The alternate breast in two of the cases showed the increase in the general inflammatory process or congestion to a lesser degree and was free of masses. This difference between the two breasts is of great assistance in the interpretation. The case which was not incised showed multiple small masses in both breasts as well as the large mass identified as the abscess. Follow-up examinations of these cases several months later failed to show any gross scars in the breasts, though some localized thickening may have been overlooked among the still large (lactating) lobules.

#### CHRONIC MASTITIS

It is very difficult to separate the earliest changes due to inflammatory disease from the normal. If we assume that the two breasts should be alike normally, the abnormalities seen in one which are not present in the other should constitute a working basis for determining the pathological state. If a breast is cut across, the gross appearance of an area of chronic mastitis is that of an area of dense scar tissue replacing and contracting the normal structures. The edges of the diseased area are indistinct. The inflammation tends to involve the duct and lobular structures though the fatty masses may be involved. In the roentgenograms, the appearance is essentially the same: a diffuse or localized scarring and thickening along the ducts and lobules. It may involve one breast, but the process is usually bilateral. The tail and subareolar regions are usually uninvolved. Often localized areas will be slightly hazy suggesting a localized acute or subacute process.

The widespread involvement by mastitis of the majority of breasts examined was

quite a surprising discovery. The ease of infection through the ducts and the frequency of trauma probably accounts for much of this inflammatory reaction even in nulliparas. Epithelial overgrowth without serious consequences or tumor formation probably is common also.

#### BENIGN TUMORS

Benign tumors of the breast are clearly demarcated from the surrounding structures. They are usually homogeneous in density, though they do show connective tissue stroma and a typical arrangement for various types. For instance, the intracanalicular myxoma shows the whorl formation so characteristic of the gross appearance of this type of tumor. The divisions and interweaving of the masses can be clearly seen in the stereoscopic films (see case illustrated). In the fairly uniformly dense benign tumors, the only differentiation between these and malignant tumors of the same density is the continuity of the capsule and the absence of deformation of the surrounding breast structures.

#### MALIGNANT TUMORS

The chief characteristic of malignant tumors is the distortion of the nearby structures by scarring and puckering and infiltration in an irregular manner of the surrounding structures by the tumor tissue. The appearance is very much like that seen in the gross specimen when it is cut across. The tumor is recognized as a dense sheet or mass of tissue with irregular edges and feathery strands of dense tissue invading the ducts and lobules. There is invasion with puckering and thickening of the skin. Where this is present, it is often very sharply defined; often penetration through the base of the breast is present, and the metastatic infiltration into the pleura can often be traced. The infiltration into the retropectoral lymph nodes with consequent enlargement of the same, and infiltration along the lymph channels into the axilla with enlargement of these nodes can also frequently be noted (Fig. 12). Both the



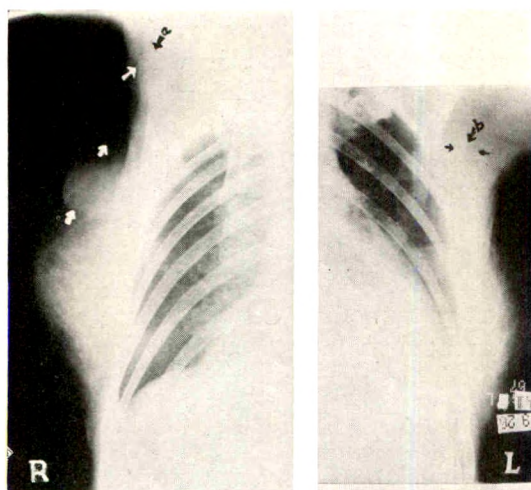


FIG. 13. Medullary adenocarcinoma, partially encapsulated, with infiltration of the skin and metastases to the axillary lymph nodes (a) which are very large and dense. Left breast shows chronic mastitis with subacute changes and two small axillary lymph nodes which are barely visible (b).

adenocarcinoma of the medullary type and the scirrhus type show this change, the only differentiation being that in the scirrhus type there is more shrinking and scarring and diffuse infiltration than in the

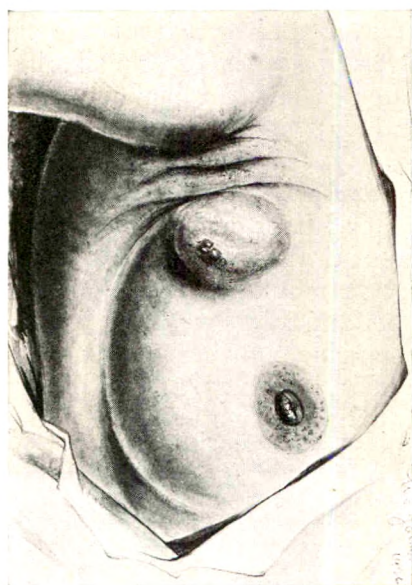


FIG. 14. Clinical appearance of same case as in Figure 13 before operation.

medullary type. In the medullary type, the infiltration may occur at only one or two places, usually toward the base or toward the skin, the tumor mass being fairly sharply outlined elsewhere. In certain medullary types of tumors, very rapidly growing, there may be so much expansion of the tumor as to give a sharp border from compression, giving the appearance of a



FIG. 15. Cross section of same breast as in Figures 13 and 14 showing tumor with compression of breast structures at edges giving the appearance of a capsule.

capsule (Fig. 13). The diagnosis is apparent from the invasion through this dense border into the surrounding tissues at one place or another. There is a definite, so-called inflammatory type of adenocarcinoma which involves the whole breast and is commonly bilateral. Accompanying the usual masses with infiltration surrounding them is a diffuse haziness giving the impression that an inflammatory process is coincident with the tumor (Figs. 22 to 26).

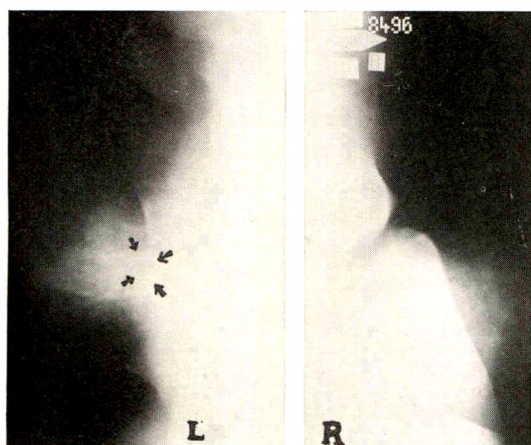


FIG. 16. Showing very little mastitis in the obese right breast. The left breast shows a small irregular infiltrating lesion (2×2 cm.) with small sheets and threads of dense tissue around its periphery. There is no scarring nor distortion of the breast architecture. Diagnosed malignant, probably scirrhus type; operation, adenocarcinoma, unclassified.

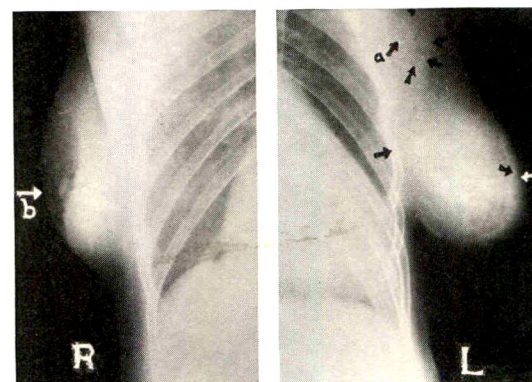
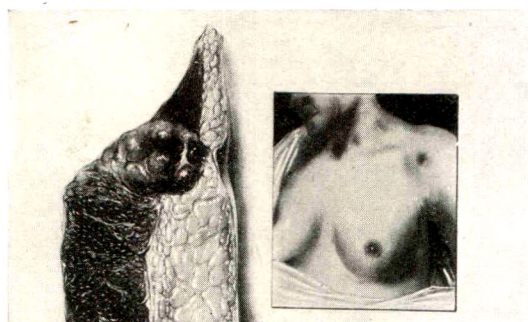
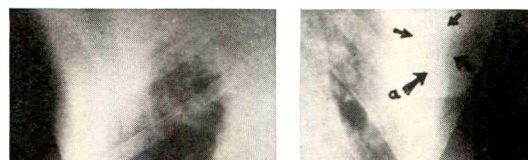


FIG. 18. Left breast: diffuse infiltration by adenocarcinoma (probably scirrhus type) with infiltration of skin and penetration of base. Axillary (a) and supraclavicular nodes are involved. Right breast: very little mastitis, practically normal type, shows nipple (b) and areola, ducts and acini. The base is free from the pectoralis muscles.

The presence of extensive chronic mastitis is very common in all of the tumor cases studied. This can be studied in the breast which is not involved by the tumor, for, as pointed out previously, the chronic mastitis is usually bilateral and usually fairly equal in its involvement of the





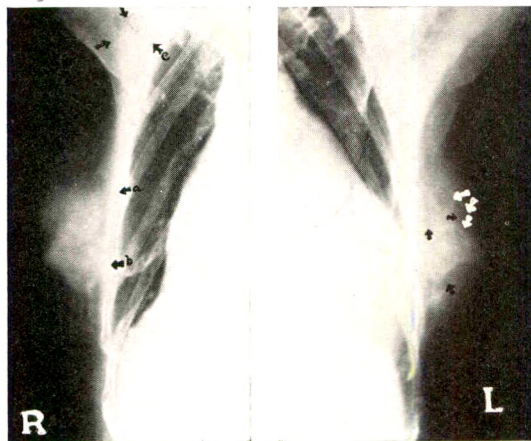


FIG. 20. Advanced medullary adenocarcinoma with ulceration of skin, infiltration through base in two places (a) and (b) and large axillary mass (c). Left breast is a normal type with a few small areas of mastitis and several small cysts.

breasts. The differentiation between the involvement by the tumor and dense infiltrative inflammatory areas is, of course, the most difficult problem which has to be met in this type of diagnosis. The gross appearance, of course, of certain types of chronic mastitis is very difficult to distinguish from early scirrhus carcinoma.

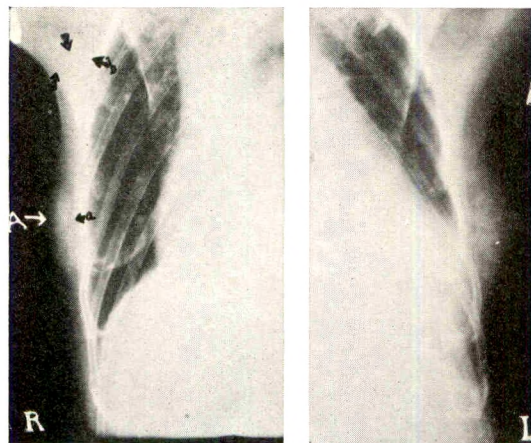


FIG. 21. Same case as in Figure 20 nine months later, showing the atrophy of left breast with the general loss of weight. Right breast, showing shrinkage of (a) original tumor, and (b) axillary mass under roentgen therapy. The patient died with a silent metastasis in the brain. Autopsy showed atrophic carcinoma cells in masses of scars in the breast.

Both cause scarring and shrinking, and both have strands of dense material invading the surrounding structures. The tumor tissue, however, in the main, is considerably denser and shows a solid mass, varying from 1 to 10 cm. in diameter. It is only the smaller masses that give difficulty in diagnosis. The larger ones are obvious. The presence of small or large cysts in the inflammatory process may further confuse the picture, especially if they are filled with fairly opaque material, for they then give the impression of a dense cellular mass

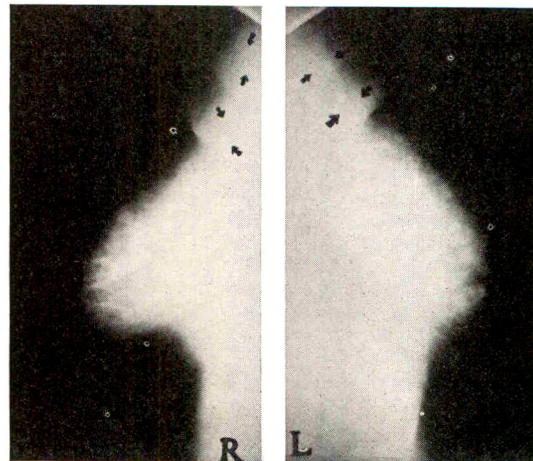


FIG. 22. Very rapidly growing bilateral medullary adenocarcinoma showing the diffuse infiltration with large masses. This picture simulates the lactating breast with abscesses except that the individual masses are very dense. There is a generalized involvement of all of the regional lymph nodes. The bases of both breasts have been obliterated by the tumor.

though their homogeneity and sharp border rather tend to differentiate them from the malignant tumors.

#### CHANGES FROM IRRADIATION

Through the courtesy of Dr. Burton Lee, 33 cases were studied from the Memorial Hospital of New York. These cases had been treated with both radium and deep roentgen therapy.

In some of these cases the usual characteristics of the tumors were evident. In others, probably the more sensitive to the





FIG. 23. Photographs showing two views of this patient with bilateral adenocarcinoma (colloid type) previous to irradiation. Note the skin infiltration.

radiation, nothing but the connective tissue framework of the tumor mass was visible. The diagnosis was evident from the scarring and distortion of the breast architecture, as well as by the infiltration into the rest of the breast, the base and muscles.

In those cases showing an erythema of the skin over the breast, the underlying breast structures were obscured by a diffuse haziness. This suggested an engorgement of the blood vessels or an actual edema of

the breast substance coincident with the skin erythema.

In cases that had not received irradiation for some time, the breast structures were unusually clearly defined, and there was very much less evidence of mastitis than there was in the opposite breast.

#### RESULTS

In this series several cases have been diagnosed as tumors when they were not

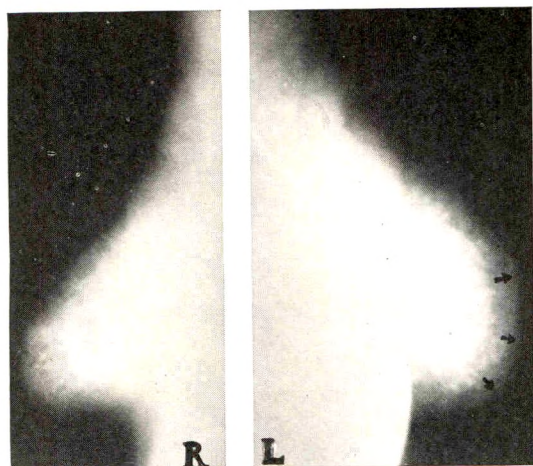


FIG. 24. Same case as in Figure 23 three months later showing the increase in the size of the breasts, increase in the density from scarring (following deep therapy); thickened infiltrated skin over both breasts, destruction of the nipple; axillary masses; infiltration through base with no demarcation of breast from chest wall. There was a very rapid recurrence of the tumor in a few days after maximum radiation treatment and the patient died.

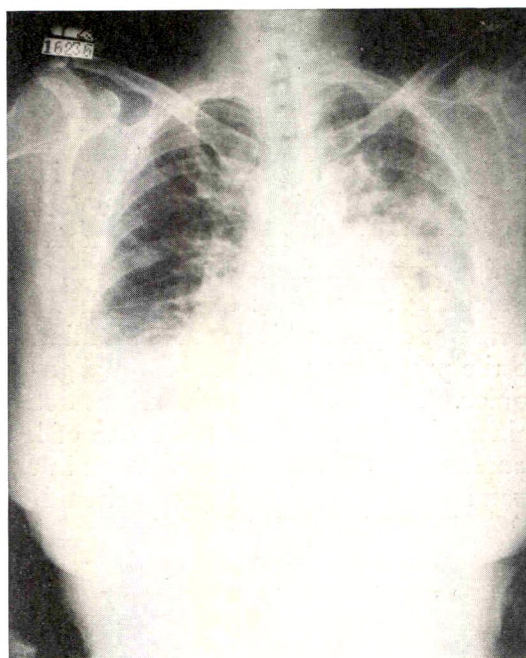


FIG. 25. Same case as in Figures 23 and 24 showing the involvement of both lungs by the metastatic process.



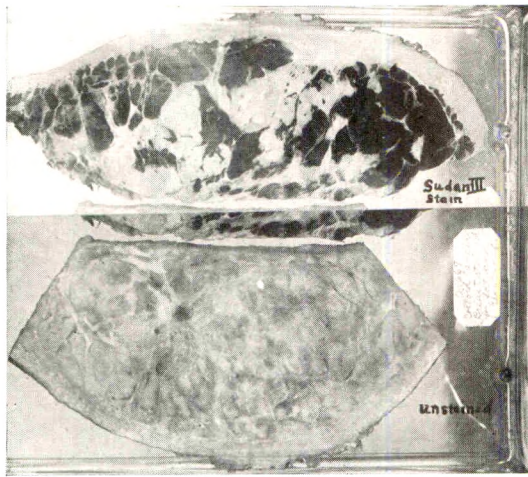


FIG. 26. Specimens showing tumor masses and skin infiltration. The specimen above is stained with Sudan III to show the fat lobules (see roentgenogram of this specimen in Fig. 27).

suspected clinically, and operation has proved that the diagnosis was correct. The tumor masses in each case were less than 1 cm. in diameter, but gave the typical infiltrating and scarring characteristics of an early scirrhus type of carcinoma. Several cases have been erroneously diagnosed as chronic mastitis with cysts. These patients were operated upon because of the masses in the breast, and the masses were found to be scirrhus carcinoma. This error in diagnosis was due in great part to inexperience and a hesitancy upon the part of the examiner to make a diagnosis of malignancy from the roentgenograms, thus subjecting the patient to operation when there was considerable doubt in his mind as to the presence or absence of a malignant tumor. This sort of experience has determined the future policy to be one of less conservatism. In any case of doubt in the examiner's mind, the diagnosis should be "? early carcinoma," "? cystic mastitis." This corresponds to the experience of a great many surgeons when they are in doubt about the presence of tumor from the clinical examination and history. With masses present, it has been found safer to excise the breast than to make a conservative diagnosis. The great rapidity of wide-

spread metastases with the rapid change from hopeful to hopeless state makes this viewpoint justifiable. In many of the cases, there was no unanimity of opinion in the preoperative clinical diagnosis. Several opinions were often held as to the presence of malignant or benign tumors in each case. The opinion from the roentgenogram, on the other hand, was often very definite and, most frequently, correct.

In most of the 8 cases diagnosed incorrectly in the whole series of 119 cases, there was a great deal of disagreement as to the diagnosis clinically. After having more experience, the interpreter reviewed the 8 cases wrongly diagnosed. Four of these were obvious; 3 were malignant, and one was an extensive mastitis. The encapsulated malignant tumor (Fig. 13) would be missed again. A fibroma with mastitis of very dense type would probably be called malignant again. The 2 cases said to be



FIG. 27. Same case two days later than Figure 24. Roentgenogram of a section of the right breast through site of nipple showing infiltration of skin by tumor. Tumor masses of all sizes are visible within the breast substance. Specimen stained with Sudan III (see Fig. 26).

negative by the pathologist could not be studied because the specimens were thrown out before films could be made to locate the supposed small area of malignancy seen at the original examination.

Of the 43 cases coming to operation or post mortem, 33 were examined by dissection after the films were interpreted. Roentgenograms were frequently made of the specimen to study the details when the suspected area could be placed closer to the film. It is only by such follow-up methods that any accuracy can be obtained in diagnosis. Mastitis is so common and widespread that its characteristics must be very carefully studied in order to discriminate it from an early tumor. Serial studies are also of distinct advantage.

Table 1 shows in brief the results of this preliminary study. Of 86 cases of all types from the Strong Memorial Hospital, 43 came to operation or autopsy and can be considered proved. Eight of this series were wrongly diagnosed. On review of the roentgenograms in the light of further experience, at least 4, or one-half of this group, would not be missed. A large part of the remaining 43 cases have been under clinical observation for one to two years. Many have had serial films. None have shown evidence necessitating a change of diagnosis so far.

Of the 33 cases from the Memorial Hospital, New York, 6 had biopsy to verify the diagnosis. Since these were all advanced cases, the diagnosis was mostly obvious.

TABLE I  
COMPARATIVE ACCURACY, CLINICAL VERSUS ROENTGENOLOGICAL DIAGNOSIS

Diagnosis by Film	Correct	Incorrect	Proved by operation or autopsy
Malignant tumor.....	22	3	25
Encapsulated malignant tumors.....		1	1
Probably malignant—at operation malignant.....	3		3
Probably malignant—at operation benign.....		1	1
Probably malignant—at operation mastitis.....		1	1
Probably malignant—at operation negative.....		2	2
Intracanalicular myxoma.....	1		1
Chronic mastitis—no symptoms—(2 years).....	4		
Chronic mastitis—no symptoms—(1 year).....	24		2
Chronic mastitis with cellular masses, cysts, calcified masses, fibrosis—all non-malignant (1-2 years).....	14		4
Prepartum changes.....	3		
Postpartum changes.....	3		
Postpartum—lactating.....	1		
Lactating—with acute abscesses.....	4		3
Simple obesity (1-2 years).....	7		
Simple changes.....	3		
Total.....	86	8	43
<i>Irradiated Cases from Memorial Hospital, New York City</i>			
Malignant.....	23		5
Probably malignant.....	6		
Chronic mastitis.....	1		1
Chronic mastitis with cysts or benign tumors.....	3		
Total.....	33		6
Grand Total.....	119	8	49



Of the total 119 cases, leaving the original figure of 8 cases wrongly diagnosed, the percentage of error is 6.7 per cent. Taking only the proved cases, totalling 49, the percentage is 16.3.

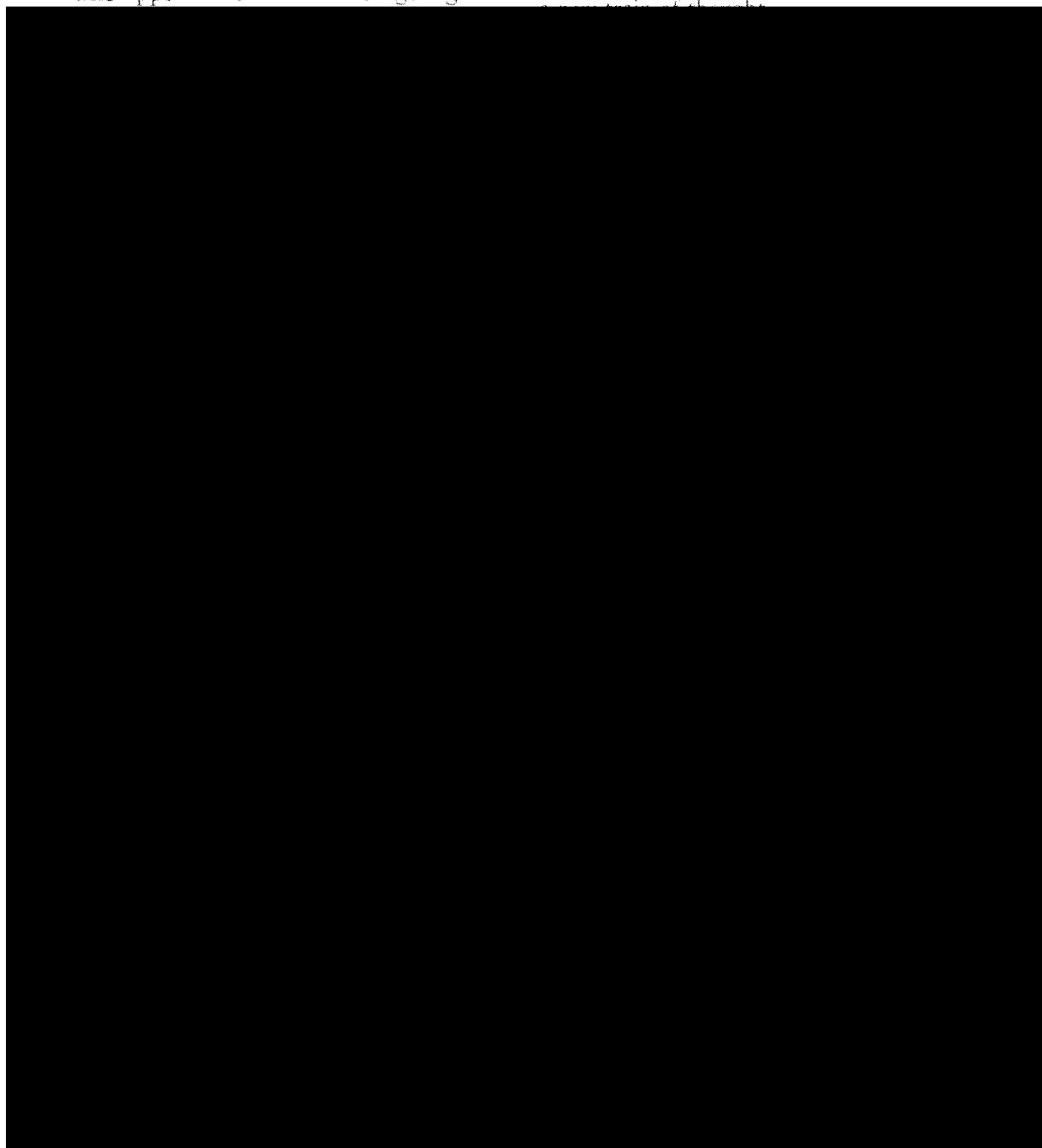
#### SUMMARY AND CONCLUSIONS

A simple technique for taking stereoscopic roentgenograms of the human breast is described.

The appearance in such roentgenograms

#### DISCUSSION

DR. P. M. HICKEY, Ann Arbor, Mich. It was my good fortune two years ago to be at Rochester where I saw the early work of Dr. Warren. I wish to congratulate him on presenting such an important new contribution to roentgenology. At first sight one may be somewhat doubtful as to its practical importance but the same objection has been raised with other contributions which have been made. I think the work is basic and should stimulate us along



# SUBPHRENIC ABSCESS\*

By E. P. McNAMEE, M.D.

CLEVELAND, OHIO

THE clinician is sometimes confronted with the problem of making the diagnosis of a condition which has physical signs common to a pathological process involving the structures either in the base of the thorax or in the upper region of the abdominal cavity. In order to make the diagnosis, he finds it necessary to call upon the roentgenologist for his assistance. The roentgen examination frequently gives the most precise and definite information in regard to the character of such a process. The condition which most frequently offers such difficulty in diagnosis is subphrenic abscess.

Subphrenic abscess is attended by a very high mortality rate if not treated by surgical drainage. With an early and a correct diagnosis and proper surgical treatment, the mortality rate may be reduced about 60 per cent. A complete roentgen examination, with an accurate interpretation of the roentgen evidence, is one of the most essential aids in making the diagnosis of this condition.

A review of the literature shows that much has been written on the subject of subphrenic abscess. It was first described by Barlow<sup>1</sup> in 1845. In 1880 von Leyden<sup>1</sup> published his article on "Pyopneumothorax subphrenicus." He established criteria for making the diagnosis clinically and reported three cases which he had diagnosed during life and in which the diagnosis was confirmed by autopsy. In 1908, Barnard<sup>2</sup> published one of the best articles on this subject which appears in the literature. He describes the anatomy of the subphrenic space and presents a very clear description of the general subject. He describes in detail the etiology, symptomatology, physical signs, diagnosis and treatment of subphrenic abscess occurring in each of the six subphrenic spaces. In

1921, Lockwood<sup>3</sup> published his observations, reporting 113 cases observed at the Mayo Clinic. Many others have contributed valuable information, emphasizing various phases of the subject.

## ETIOLOGY

Subphrenic abscess may follow infection in the peritoneal cavity or in any of the organs or structures in contact with the under surface of the diaphragm. Rarely, it may follow infection in the lung or pleural cavity. About one-sixth of the cases result from distant foci of infection. Cases have followed carbuncles and infected burns. About two-thirds of the cases follow abdominal operations. Perforated gastric or duodenal ulcer, and appendicitis, are the cause of more than half of the cases. The etiology seems to vary with the prevalence of certain diseases in different localities. This is illustrated in the 76 cases reported by Barnard.<sup>2</sup> One-sixth of these were due to hydatid or to tropical abscess of the liver. In 15 proved cases at St. Alexis Hospital, the etiology was as follows:

Appendicitis.....	8	about 53%
Ruptured Ulcer:	5	about 33%
Gastric.....	3	
Duodenal.....	1	
Gastrojejunal.....	1	
	—	
Trauma, with fracture of the	5	
lower right ribs and injury		
to the right abdomen.....	1	
Unknown.....	1	

## ANATOMY

A knowledge of the location and boundaries of the subphrenic spaces is essential for a thorough understanding and proper interpretation of the signs elicited by roentgen examination. Only with such knowledge can one accurately designate

\* From the Roentgenological Department, St. Alexis Hospital, Cleveland, Ohio.

m. j.  
1908  
vol. I

the location of the abscess. The subphrenic space is divided by the cruciform arrangement of the ligaments of the liver. The falciform ligament divides the space into right and left and these, in turn, are divided into intraperitoneal and extraperitoneal by the peritoneal reflections on the liver. In the literature there appears some difference of opinion as to the limits and boundaries of these spaces, but the description presented by Barnard<sup>2</sup> is generally accepted and quoted. He divides these spaces as follows:

- (A) Intraperitoneal: I Right 1. Anterior  
2. Posterior  
II Left 3. Anterior  
4. Posterior  
(B) Extraperitoneal: 5. Right  
6. Left

The right anterior intraperitoneal space is the only true subphrenic intraperitoneal space on the right side. The right posterior intraperitoneal space is the subhepatic fossa. The left anterior intraperitoneal space is the only true subphrenic intraperitoneal space on the left side. The left posterior intraperitoneal space is the lesser peritoneal cavity. There is free communication between some of these spaces. The right and left paracolic grooves are continuous with the right and left subphrenic spaces. These communications make it possible for infection to spread from one space to another and also for infection to get into these spaces from the pelvis or the lower abdominal regions. With the patient lying on the back, in a horizontal position, the highest part of the posterior abdominal wall is the lumbar region. This forms a watershed. This watershed is important because it acts as a barrier, causing infection to gravitate either into the pelvis or into the subphrenic space. This is one of the fundamental reasons for the adoption of Fowler's position for the prevention of subphrenic abscess in the presence of infection in the peritoneal cavity.

#### PATHOLOGY

The pathology of a subphrenic abscess in the intraperitoneal space is that of a localized peritonitis. At first, there is a profuse exudation of serum with symptoms of peritonitis. In a few days, the serum becomes turbid with leucocytes. The margins of the infected area begin to be defined about the fourth day by a lymph barrier, which localizes and contains the forming abscess. At first, the contents are diffused in irregular spaces, but, as time goes on, the barrier contracts and limits the space. It takes from eight to fourteen days for the abscess to become localized. Any of the pus-forming organisms may be found in the abscess.

#### HISTORY

The history of a subphrenic abscess is that of the disease or condition which is the cause of the abscess, in addition to which there is the history of an infective or suppurative process. The history often is obscure in the insidious cases, especially in those which do not follow a surgical operation. Two-thirds of the cases follow abdominal operations. To think of the condition is a great aid in making the diagnosis. Subphrenic abscess always should be suspected in the presence of an unexplained fever following an abdominal operation, in just the same manner as empyema is suspected when a septic temperature follows pneumonia. In those cases which follow ulcer of the stomach or duodenum, the onset is usually not abrupt. As a rule, there is clinical evidence of a ruptured ulcer, which is followed by symptoms and signs of a suppurative process. These symptoms merge so that the presence of a subphrenic abscess may not be suspected until the signs of a pathological process at the base of the chest become pronounced. In a case following operation for appendicitis, there is usually definite improvement for a certain interval of time, followed by signs of a suppurative or infective process, with evidence of involve-

ment of the structures at the base of the chest. These signs are often mistaken for empyema or pneumonia.

#### PHYSICAL SIGNS

There are present the general signs of sepsis, with irregular temperature, loss of weight, sweating and weakness. The temperature ranges from  $99^{\circ}$  to  $102^{\circ}$  F. The pulse is usually around 120. The respiratory rate is little affected; it is not commensurate with the elevation in temperature and pulse, nor with the apparent extensive involvement of the structures within the chest. Examination of the chest reveals signs of compression and, at times, inflammation of the lower portion of the lung on the affected side. These signs are often mistaken for empyema or pneumonia. The position of the heart and mediastinal structures is important in the differential diagnosis. They are not displaced in subphrenic abscess, while in empyema there is definite displacement away from the affected side. There is no evidence of excursion of the diaphragm. Theoretically, there should be an increased flare of the costal arch on the affected side but this is not always present, as is so well pointed out by Dexter.<sup>3</sup> All of the cardinal signs of underlying inflammation may be present. Pain and edema in the region of the abscess occur in many of the cases. Pain, referred to the neck or shoulder, or along the distribution of the intercostals, is not uncommon and is often one of the earliest and most significant symptoms. The liver is rarely displaced downward; it is usually fixed by adhesions along its lower border and, as a result of this, the diaphragm is displaced upward, causing an apparent increase in the vertical liver dullness.

#### ROENTGEN EXAMINATION

The roentgen evidence, properly interpreted, is of great value in making the diagnosis of subphrenic abscess. In those cases in which fluid and gas are present, the diagnosis can be made by the roentgenologist alone; but when no fluid level can

be seen, the roentgen evidence is more difficult to interpret and the diagnosis can only be made by correlation of the roentgen findings with the clinical symptoms.

In order to obtain all the roentgen evidence, roentgenoscopic and roentgenographic examination must be made. The roentgenoscopic examination is facilitated by the use of a tilt roentgenoscopic table. The patient may be placed on the table when it is in a horizontal position and then, with little discomfort, the patient may be examined in various positions by tilting the table from the Trendelenburg to almost the vertical position. Very sick patients may be elevated to an angle of  $45^{\circ}$  without much discomfort and most of them may be elevated to  $75^{\circ}$ . This is very important in the search for fluid levels.

The roentgenoscopic observation gives information which is important in determining the various positions in which roentgenograms are to be made. The following points should be noted in the roentgenoscopic and roentgenographic examination:

1. The position of the mediastinal structures.
2. The position, contour and excursion of the diaphragm.
3. The condition of the lung space.

In the uncomplicated case, the heart and mediastinal structures are not displaced. The diaphragm on the affected side is elevated, usually, to the level of the third or fourth rib anteriorly. The arch is more acute than normal. There may be slight excursion, but the diaphragm is usually fixed in its position. The lung space above the diaphragm is clear. If gas is not present in the abscess, the density beneath the diaphragm is homogeneous and cannot be differentiated from that of the liver. The vertical liver density is increased. When gas is present in the abscess, if the patient is placed in an upright posture, there will be an area of decreased density just below the diaphragm, with a fluid level below the gas. Waves can be



produced in this fluid level by shaking the patient.

Roentgenograms made in the postero-anterior position will show whether the abscess is on the right or left side. Roentgenograms made in lateral position will often show in which space it is located. If the abscess has been present for any considerable period, there is often a small area of density found in the costophrenic angle. This is due to pleuritis, with a small amount of fluid. When the abscess occurs on the left side, with gas and fluid level, the fluid is seen to be agitated by each heart beat, forming a wave. If gas is present in the abscess, the limits of the abscess cavity can be determined by making roentgenoscopic or roentgenographic observations of the patient in various positions.

A considerable number of these patients are referred to the roentgenologist with a diagnosis of empyema and the striking feature of the case is the fact that there is no roentgen evidence to support the diagnosis of empyema, in spite of the apparent marked clinical evidence of it. The heart and mediastinal structures are in normal position; the diaphragm is elevated and usually fixed in its position, and the lung space is clear. This combination of facts clinches the diagnosis. If there is gas present in the abscess, with a fluid level, the diagnosis is easily made.

Subphrenic abscess may be single or multiple. It may occur on both sides at once or there may be several pockets on one side. When a pleuritis or pneumonitis following subphrenic abscess has become extensive, there is marked density in the lung space, obliterating the outline of the diaphragm and making it impossible to determine the presence of a subphrenic abscess by roentgen examination unless gas is present in it.

If, after the roentgen examination, a definite diagnosis cannot be made, it is important to repeat the examination at biweekly or weekly intervals. When the diagnosis of subphrenic abscess has been

established and drainage instituted, serial roentgen examinations, made weekly, are useful in the study of the progress of the condition, especially in regard to the position and function of the diaphragm. When drainage is sufficient and the patient is proceeding to uncomplicated recovery, there is a gradual return of the diaphragm to normal position. The return to normal function is very slow and lags behind the clinical progress. Some cases show very little excursion of the diaphragm when all clinical and subjective evidence of the abscess has disappeared. Roentgen examination of the chest is very helpful in detecting pulmonary and pleural complications of subphrenic abscess. We have observed abscess of the lung as a complication in several cases.

#### THE EXPLORATORY NEEDLE

Most writers agree that the use of the exploratory needle is dangerous practice and that its use should be condemned. Some advise its use as a preliminary step in the operation for drainage of the abscess. It is our practice not to use it and we advise against it.

#### COURSE

If the patient is not operated upon, the symptoms become more pronounced and the outcome is usually fatal. If proper surgical drainage is instituted, the symptoms subside and the patient goes on to recovery unless this is interrupted by one of the following complications: additional subphrenic abscess, abscess of the lung, spontaneous rupture into a bronchus, pleural cavity, pericardium, colon, stomach, or through the skin. One of our cases developed an additional subphrenic abscess and abscess of the lung, with fatal termination. In another case, following gangrenous appendicitis, there developed an abscess of the lung and an abscess in the pelvis. Surgical drainage of the abscess of the lung and of the abscess in the pelvis was instituted and the patient made complete recovery. Three cases had spontaneous rupture: one, into the pleura,

with fatal termination; one, into a bronchus, and one, into the colon; both made complete recovery. Lockwood<sup>5</sup> points out that there is little danger of spontaneous rupture of subphrenic abscess into the peritoneal cavity.

#### TREATMENT

Recovery from subphrenic abscess is dependent upon free drainage, either spontaneous or surgical. Spontaneous drainage through a bronchus, through the intestinal tract, or through the skin, may occur with recovery, but it is rare. Surgical drainage offers the best chance for recovery. To obtain the maximum benefit from surgical treatment, the location of the abscess must be determined and the method of approach to the abscess must be governed by the stage of the inflammatory process at the time of observation. It takes from eight to fourteen days for a subphrenic abscess to become localized. In general, in the stage of diffuse inflammation, drainage through the abdomen gives the best results. After the abscess has become localized, the transpleural method is advisable. Of course, the latter procedure is to be done in two stages, unless pleural adhesions, which will protect the general pleural cavity from infection, have already formed.

#### CASE REPORTS

CASE I. (Figs. 1 and 2.) Female, aged twenty-six. Admitted to the hospital on May 13, 1925. Illness began May 10, 1925. General pain in abdomen; no nausea nor vomiting. Expelled small fetus; did not know she was pregnant. Bleeding stopped in several days and then nausea, vomiting and diarrhea appeared. The patient was operated on May 18 and an appendicial abscess high up on the right side adherent to the side of the abdomen, at the level of the umbilicus was found. Temperature before operation ranged from 99° to 102°F. Did not change after operation. Investigation was made to determine the cause of the elevation of temperature. Subphrenic abscess was

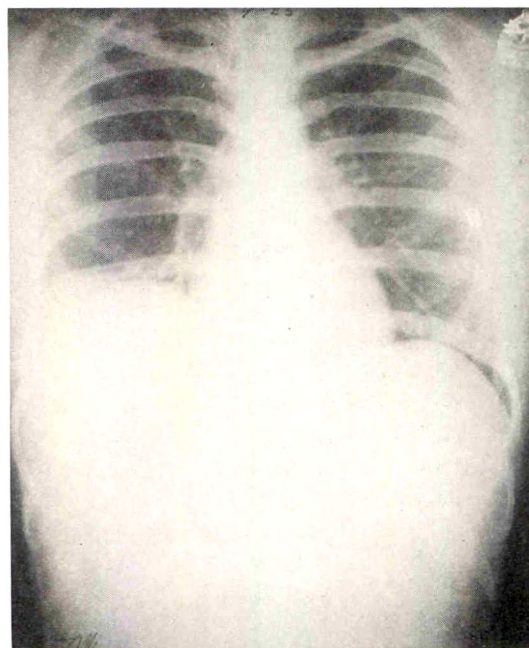
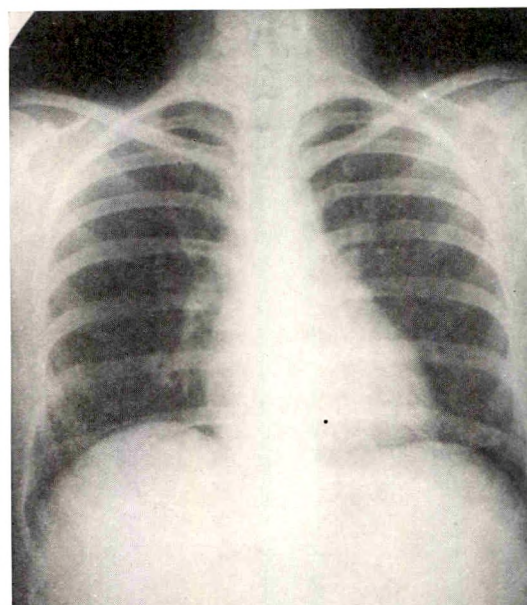


FIG. 1. Case I. June 9, 1925. Right diaphragm high, fixed in its position.

abscess was drained through the incision which had been made in the abdomen at the time of operation for appendicitis. Examination on June 9 showed the same findings. The patient





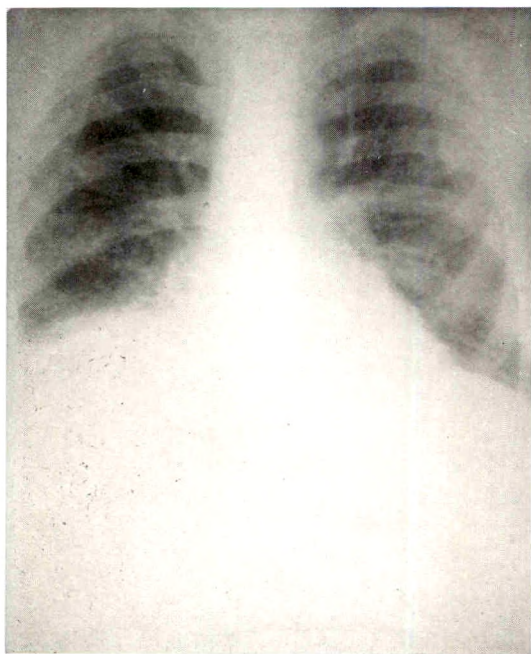


FIG. 3. Case II. Nov. 30, 1925. Subphrenic abscess on the right side, with gas and fluid level beneath the diaphragm; excursion present but very slight—almost nil.

began to show some improvement and left the hospital with the idea of returning later, if necessary, for operation for the subphrenic abscess. No further operation was performed. Roentgen examination on September 19, 1925, showed normal chest findings. The patient had made a complete recovery. Blood culture was negative; no other culture made. Etiology: appendicial abscess.

CASE II. (Fig. 3.) Male, aged forty-eight. Admitted to the hospital on November 28, 1925; discharged February 6, 1926. Two days before admission the patient had pain across the abdomen, with vomiting. Patient had hernia and was unable to reduce it. Intestinal obstruction and acute appendicitis were suspected. Signs developed in the chest indicating empyema. Roentgen examination on November 30, four days after beginning of illness, showed subphrenic abscess on the right side, with gas and fluid level beneath the right diaphragm. A two-stage, transpleural operation was performed. Pus, gas and fecal material were found beneath the diaphragm. Gastrointestinal examination on December 16

showed that there was a developmental anomaly. The cecum had not descended and was fixed in a high position beneath the liver. There was a fistula between the cecum and the abscess cavity which drained through the chest. No cultures were made. After a rather stormy period, the patient left the hospital, Feb. 6, 1926, with a discharging sinus in the chest.

The patient returned to the hospital on March 14 and after further study and consideration it was found that the patient had a fecal fistula connected with the cecum and draining out through the sinus in the chest wall. The patient was operated on with the idea of eliminating the fistula. There was a mass in the right upper quadrant, which involved the right portion of the colon and the terminal ileum, and the surgeon decided to resect the terminal ileum and the right portion of the colon and to anastomose the ileum with the remaining portion of the colon. This anastomosis was made and the terminal ileum and upper portion of the colon were removed. The patient died seven days after operation. Autopsy showed evidence of general peritonitis and bronchial pneumonia. Etiology: ruptured appendix, with perforation; appendix located in a high retroperitoneal position.

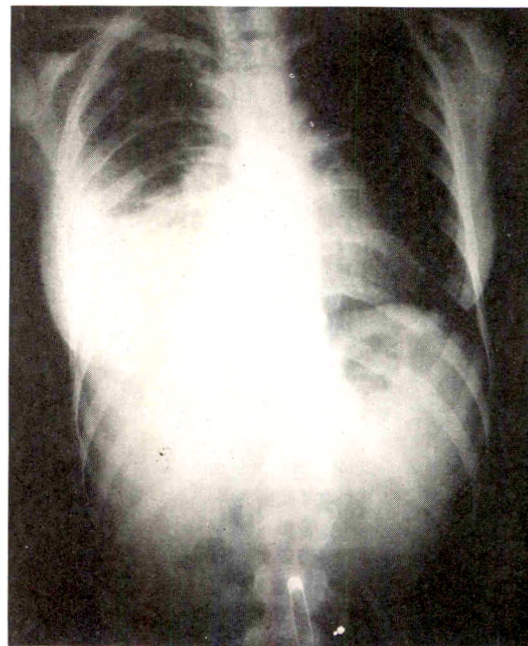
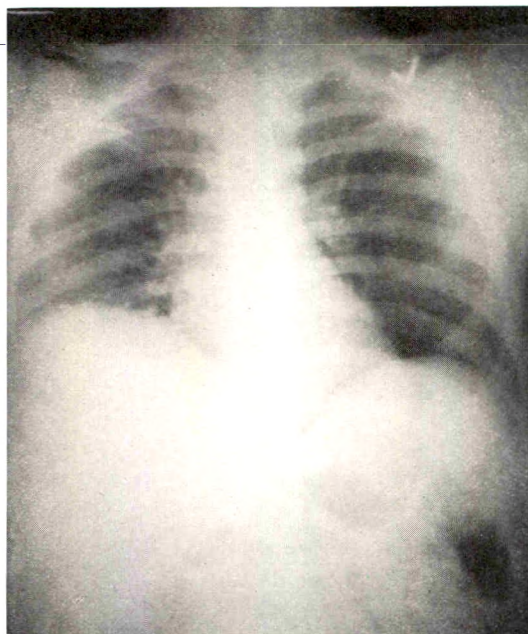
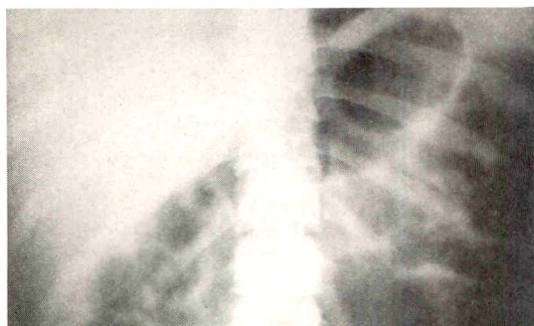


FIG. 4. Case III. Dec. 27, 1926. Subphrenic abscess on right side. No gas. Some pneumonitis at the right base.

CASE III. (Figs. 4 and 5.) Female, aged nineteen.—Admitted to the hospital on December 6, 1926; discharged January 29, 1927. Two days before admission, patient had nausea and vomiting, followed the next day by pain in the right lower quadrant, growing worse. Operation on December 6 showed a retrocecal appendix, gangrenous and perforated; free pus in the peritoneal cavity. The appendix was removed and drainage instituted. At the time of operation the temperature was  $103^{\circ}\text{F}$ . It continued high and came down to  $102^{\circ}$  on the sixth postoperative day. It ranged between  $100$  and  $102^{\circ}$  until the twenty-fourth postoperative day. Roentgen examination on December 27 showed subphrenic abscess on the right side; no gas; some pneumonitis at the right base. A transpleural two-stage operation was performed. There was pus beneath the right diaphragm. Culture negative. A second roentgen examination on January 29 showed the diaphragm about one inch higher than

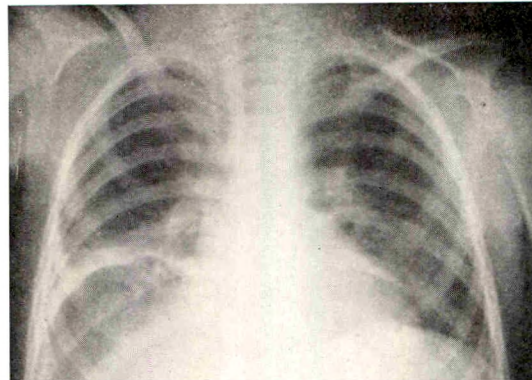






was drained and the patient made a final and complete recovery. He has resumed his previous occupation.

The study of this case shows the difficulty of making the diagnosis of subphrenic abscess in the presence of other conditions which could account for the symptoms. The diagnosis was made by a correlation of the roentgen evidence with the clinical findings. The value of serial roentgenograms is also shown by



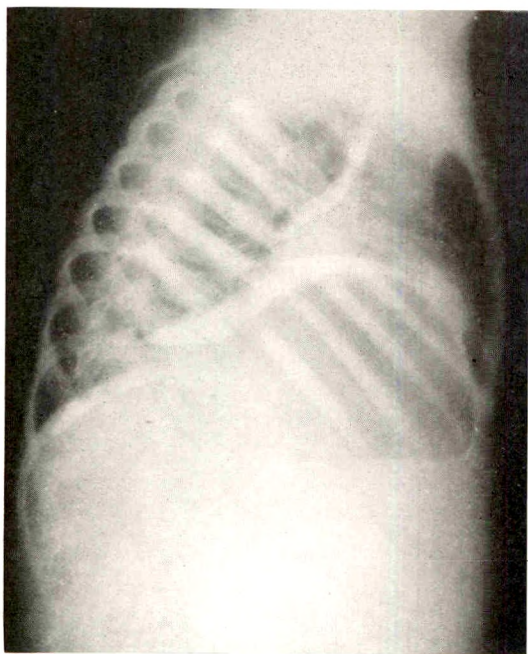


FIG. 14. Case v. Jan. 18, 1929. Lateral view, upright position, showing large gas pocket located in anterior intraperitoneal space.

30. White blood count: December 31, 19,000; January 4, 26,000; January 11, 14,000. Diagnosis; pneumonia. The patient left the hospital and returned in a week.

Second admission, January 18, 1929; discharged, January 28. Patient returned in

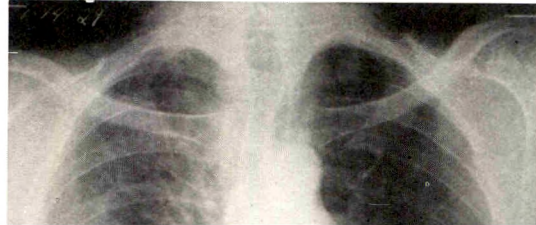
same. At this time the patient began to show evidence of some blood in the stool. Stools were described as yellow. First yellow stool January 24; blood appeared January 27. These signs indicate that the abscess ruptured into the colon and was drained by that means. Roentgen examination on January 26 showed that the subphrenic abscess was still present. Right diaphragm was one interspace lower. Amount of gas was less. Amount of fluid increased. Roentgen examination March 23 showed some limitation in excursion of the right diaphragm; adhesive pleuritis at the periphery, holding up the diaphragm. These signs are the only remaining evidence of the previous subphrenic abscess; other chest findings normal. After leaving the hospital the patient showed continual improvement and made a complete recovery. Etiology: appendicitis.

CASE VI. (Fig. 16.) Male, aged fifty-four. Admitted to the hospital November 20, 1928; discharged, December 6, 1928. Pain in abdomen and shortness of breath for four days before admission. White blood count on admission, 16,000. Operation, November 21. Walled-off abscess between cardiac end of stomach and spleen. Foul-smelling pus; no

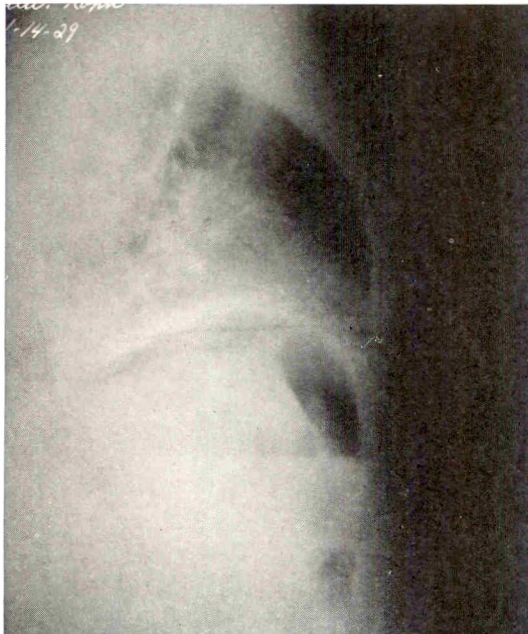


culture; drainage. Diagnosis: ruptured gastric ulcer and left subphrenic abscess. Patient left the hospital with a temperature ranging between 99 and 102°F. There was drainage through the incision and this drainage continued at home.

Returned to the hospital January 14, 1929; discharged, January 18, 1929. Just before the

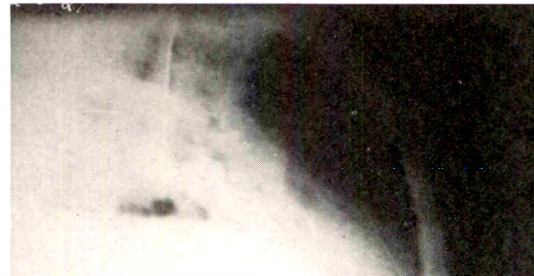




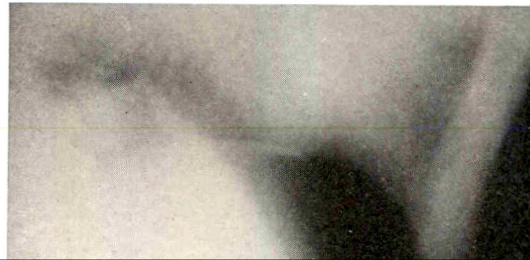


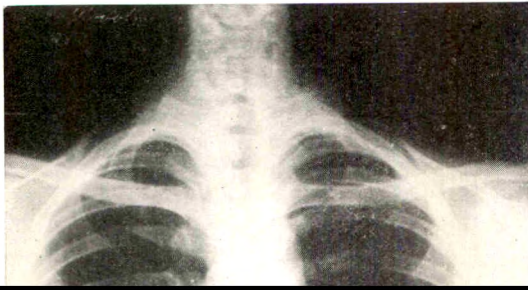
infection. No culture. No improvement after operation. Temperature ranged between 99 and 101°. Second roentgen examination on February 3 showed abscess of lung at hilus; new pocket of pus posteriorly beneath the diaphragm; additional subphrenic abscess. White blood count February 5, 26,000. Died February 9. Etiology: ruptured duodenal ulcer.

CASE VIII. (Figs. 21 and 22.) Male, aged forty. On February 7, 1927, had anterior gastroenterostomy for duodenal ulcer. Returned

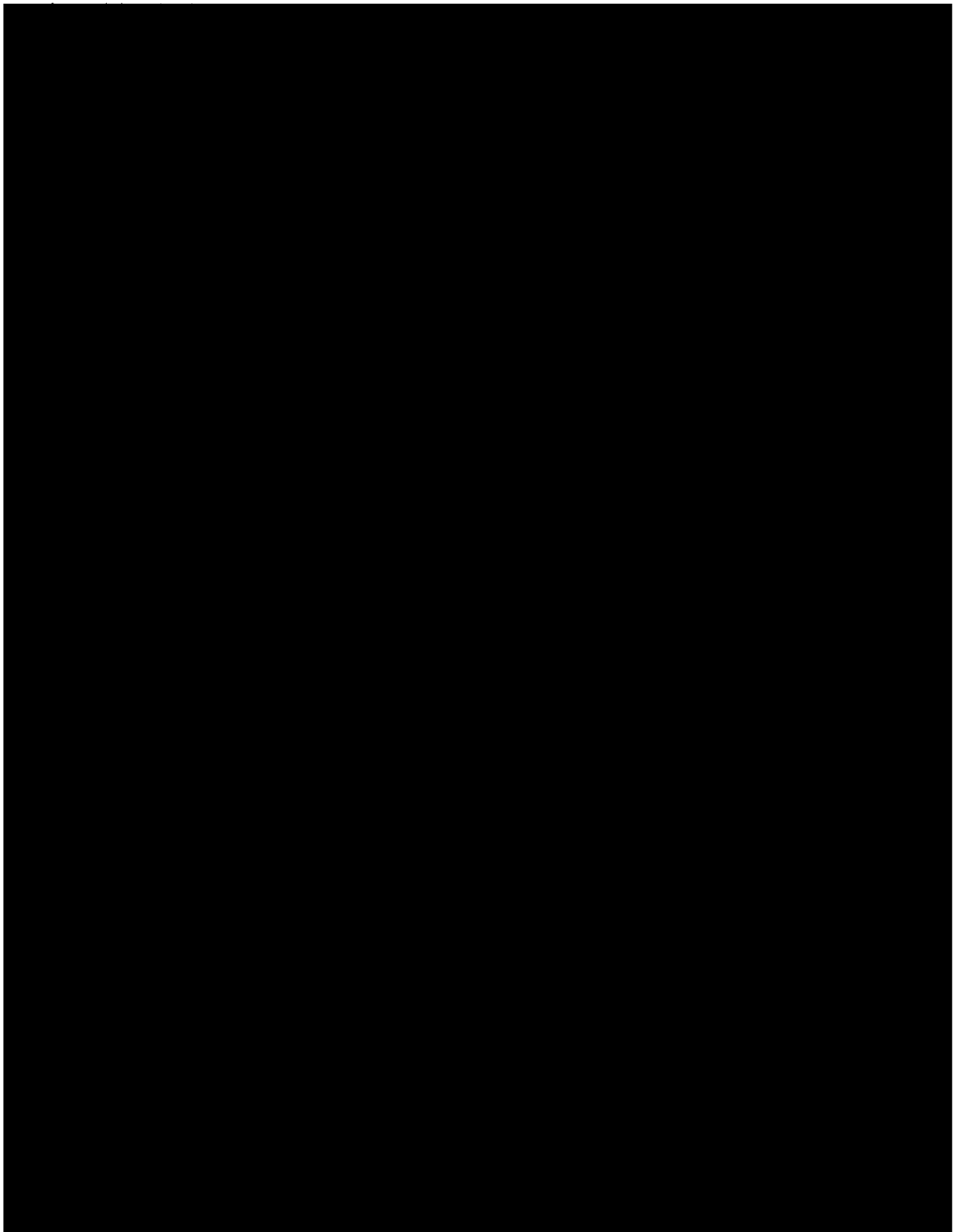


enterostomy visualized. Little barium passed into the distal loop. Some six-hour gastric retention. Operation October 16. Left abdominal incision. Left subphrenic abscess. Large amount of foul-smelling pus. Perforated gastroduodenal ulcer. Abscess was drained. Ulcer was turned in. After recovery from this operation the patient was again examined roentgenologically, on December 10. Chest showed





There were signs of pathology in the chest. No definite diagnosis was made. Patient progressed fairly well for about one week, when suddenly he developed shortness of breath and pain in the right chest. He was then admitted to the hospital and right chest was tapped. Foul-smelling pus was removed. On admission, temperature 102°, pulse 120, respirations 44. Physical examination showed heart rapid and displaced to the left. Dullness





## THE ROENTGEN APPEARANCE OF THE CHEST OF THE NEW-BORN INFANT\*

By JOHN T. FARRELL, JR., M.D.

PHILADELPHIA, PENNSYLVANIA

WHILE much has been written about the roentgenology of the adult chest and of the infant's chest affected by disease, relatively little appears in the American or English literature concerning the appearance of the chest of the normal newborn child, the studies of DeBuys and Samuel,<sup>2</sup> Wasson,<sup>6</sup> and more recently Weymuller, Bell and Krahulik,<sup>7</sup> being the best known. Because of this, Dr. Ralph M. Tyson, pediatrician to the maternity wards of the Jefferson Hospital, under the direction of Dr. P. Brooke Bland, suggested that such a study would be of value. One hundred and fifty-nine infants were roentgenographed within forty-eight hours of birth, most of them within the first day. Ten days later the children were again examined and some of them again when six months of age.

### ANATOMICAL FINDINGS

The still-born, full-term infant's chest presents on the roentgenogram an even density in which the heart and airless lungs cannot be distinguished from each other or

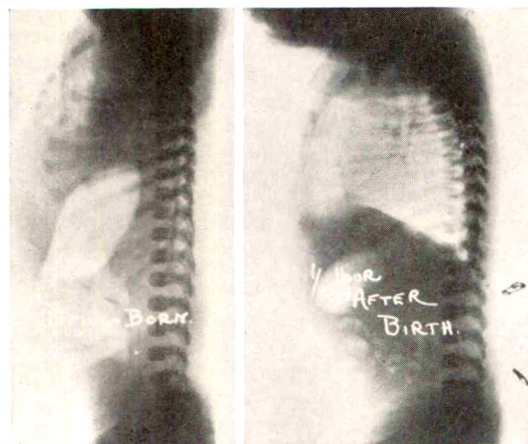
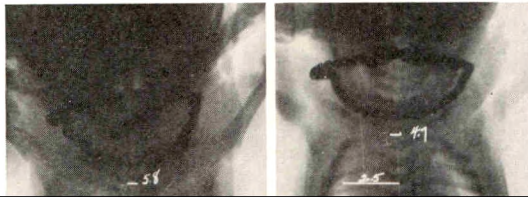


FIG. 2. Lateral view of the chest of a still-born infant and of a live infant thirty minutes after birth. In the still-born the unexpanded lungs are evenly dense, the spine is straight and the ribs are close



one. The heart, lungs, great vessels, and often the thymus, can be seen as independent structures because of the transparency of the lung fields.



eter than the upper, and the sternum as the most anterior portion of the skeletal framework stands out in relief.

#### ANTHROPOMETRIC FINDINGS

The films of 96 infants, 39 male and 57 female, of the total 159 whose chests were roentgenographed, were measured. The remaining 63 were not measured because they were not true anteroposterior exposures made with the infant lying evenly on



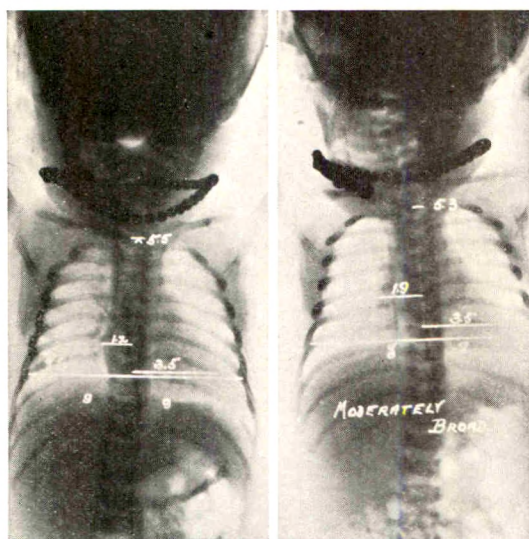


FIG. 5. Heart with broad apex and narrow base.

length a second line was drawn through the center of the spine at right angles to this first line, and the distance from the diaphragmatic line to the upper border of the first rib recorded as the length (Figs. 3 to 14).

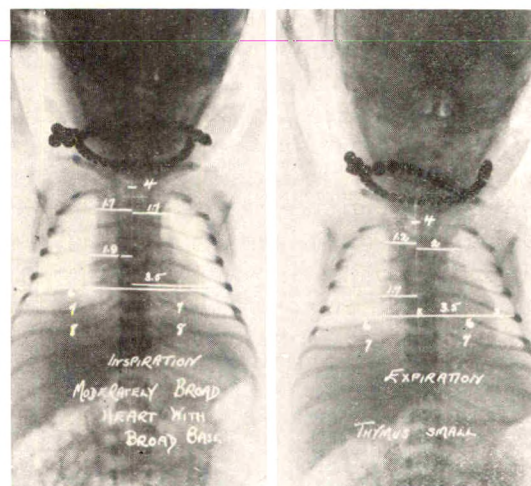
The average thoracic width for all babies was 9 cm.; the males were slightly larger than the females, the width in the former averaging 9.1 cm., and in the latter 8.9 cm. The average length was 5 cm., the males again being slightly larger with a mean of 5.1 cm., while that for the females was 4.9 cm.

These findings are in keeping with the usually accepted birth-weight figures in that the average weight of male infants is greater than that of the females.

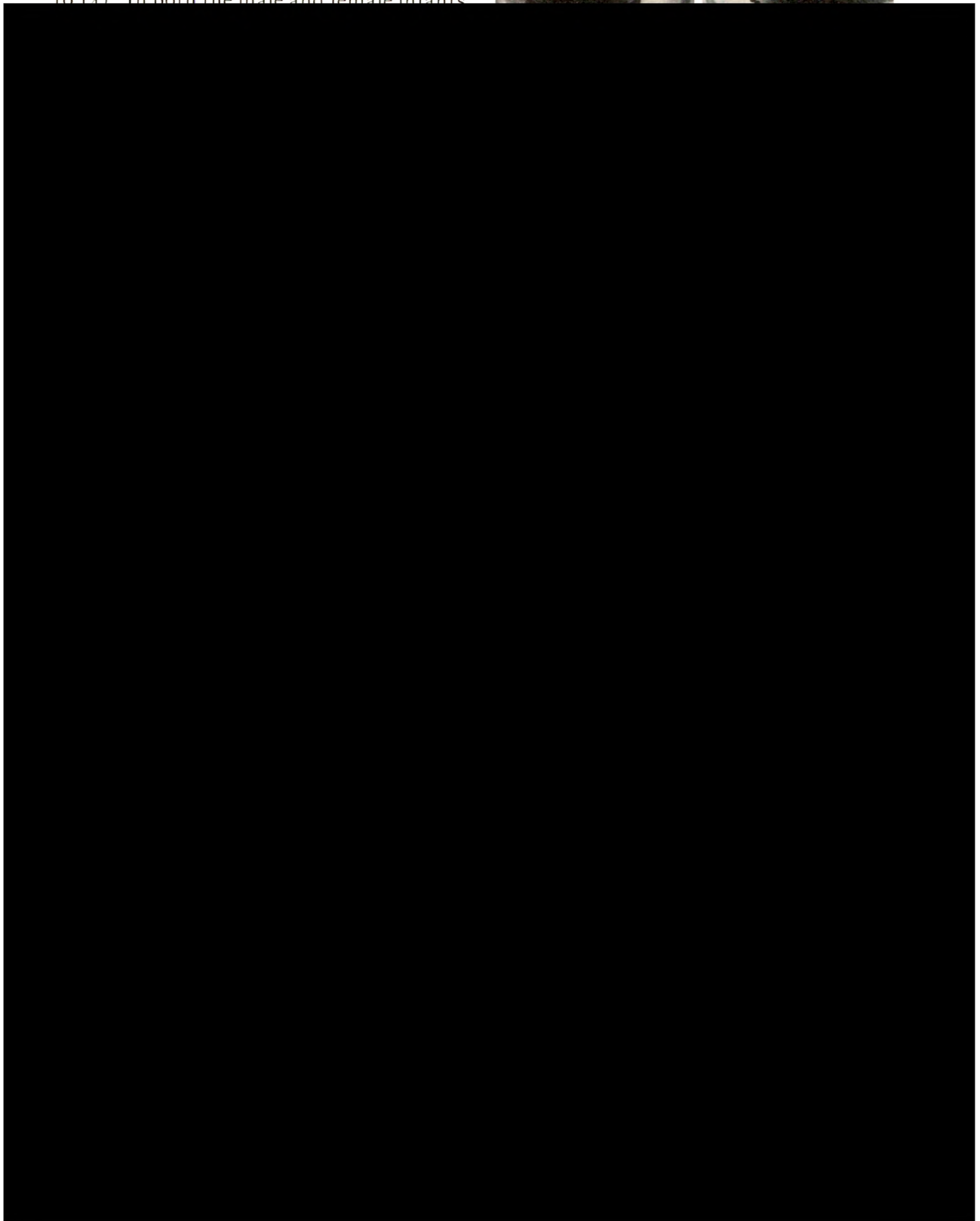
Cardiac measurements were obtained from films made at inspiration. Manges<sup>3</sup> has demonstrated in his work on foreign bodies in the air passages that the respiratory cycle and the crying effort definitely influence the size of the heart. With normal quiet breathing the thoracic cavity grows smaller and the diaphragm rises as the air is gradually expelled during the expiratory phase. As the thoracic cavity diminishes in length with the rising dia-

that the apex is swung farther to the left and the base farther to the right. The transverse diameter of the heart therefore increases during this phase, and the projected cardiac shadow occupies a proportionately greater area at expiration than it does at inspiration (Fig. 3). Manges showed that the reverse of this is true as far as the heart shadow is concerned during the forced expiration incidental to the crying effort. The narrowed glottic chink offers a decided resistance to the egress of the air as the infant forcibly contracts the chest to increase the volume of sound; the intrapulmonary pressure is raised as a result, and the heart swings on its long axis, the apex coming forward, the base backward. Its narrower diameter is, therefore, presented; the projected area is lessened for the greater part of this phase and is only broad for a moment at the extreme end of expiration (Fig. 4). In the crying child, unless one makes the exposure at this final instant of expiration, he will find that the transverse cardiac diameter is less than it is at inspiration even though the chest has narrowed and the diaphragm has risen.

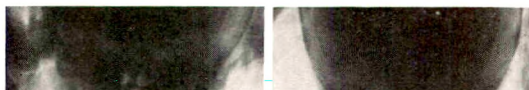
The transverse diameter of the heart was determined by measuring the distance it extended to the right and left by lines



drawn at right angles to the spine (Figs. 3 to 14). In both the male and female infants







essentially a broad organ. With the onset of respiration, pressure of the surrounding structures changes its outline. The lungs

able even though it was not seen before  
(Fig. 9).



presented a very similar cardiac outline in the later roentgenogram. This finding was also true in the two intermediate groups,

those with the broad apical and narrow basal outlines, and in those with broad apices and broad bases.

## REFERENCES

1. COPLIN, W. M. L. Morphology of the human thymus. *Pub. Jefferson Medical College and Hospital*, 1915, 1, 116.
2. DEBUYS, L. R., and SAMUEL, E. C. Shadows in thorax of new-born. *Am. J. Dis. Child.*, 1922, 24, 397-403.
3. MANGES, W. F. The roentgen-ray diagnosis of non-opaque foreign bodies in the air passages. *AM. J. ROENTGENOL.*, 1922, 9, 288-303.
4. NOBACK, M. A. A contribution to the topography of the thymus gland, with particular reference to its changes at birth and in the period of the new-born. *Am. J. Dis. Child.*, 1921, 22, 120-144.
5. WALSH, J. Pulmonary activity greatest at the apex and least at the base. *Am. Rev. Tuberc.*, 1926, 14, 142-163.
6. WASSON, W. W. A roentgenographic study of the infant chest as seen at birth. *J. Am. M. Ass.*, 1924, 83, 1240-1243. Radiography of the infant chest with special reference to the "progression of the chest and the determination of the normal." *Radiology*, 1925, 5, 365-398.
7. WEYMULLER, C. A., BELL, A. L. L., and KRAHULIK, L. Roentgenographic changes in the thorax of normal new-born babies; daily roentgenographic study of 25 normal babies during first 14 days of life. *Am. J. Dis. Child.*, 1928, 35, 837-855.

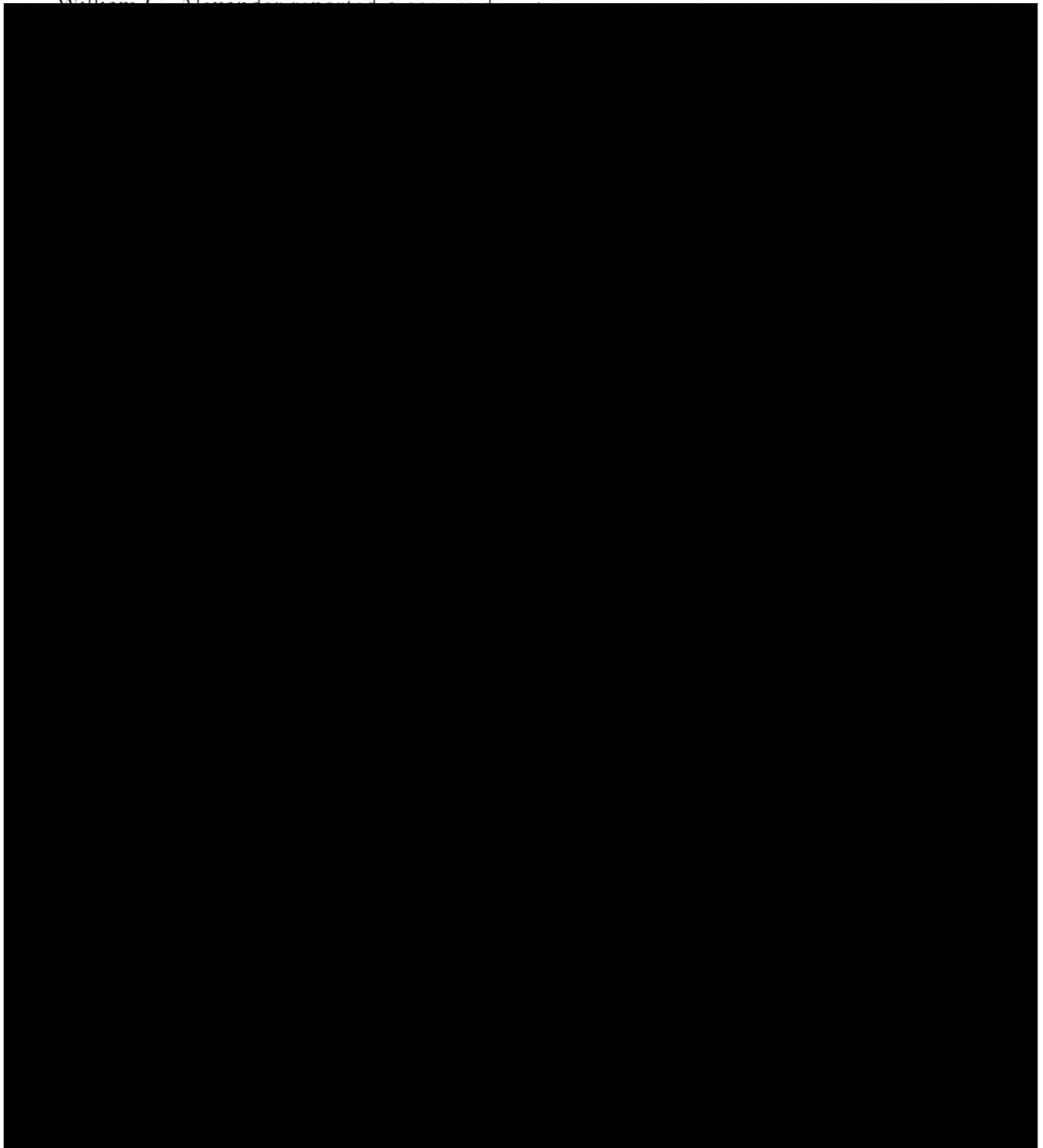


## THE DEVELOPMENT OF MARBLE BONES\*

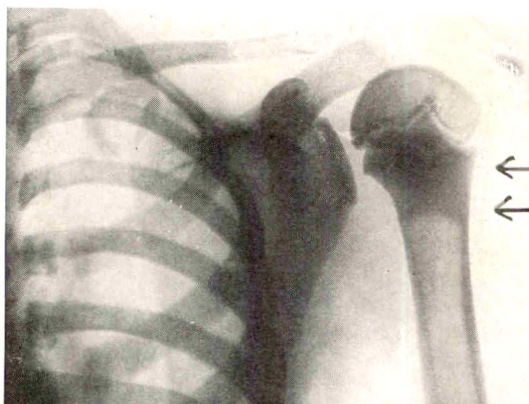
By A. HOWARD PIRIE

MONTREAL, CANADA

ALBERS-SCHÖNBERG first described the condition known as marble bones in 1904. Before this Society in 1923 Dr. William C. Albers-Schönberg examined roentgenologically at intervals of twenty-one months. At first examination they presented the following character-







Roentgen examination of the three related children twenty-one months later showed that in each case the marble condition of the bones had increased. In each case the extension in the long bones had gone farther into the medulla. This extension is not due to formation at the epiphyseal line, but evidently the process starts there and goes on extending through the bones. The extension was greater in the girl of eleven than in the other children and brought her condition nearly up to the fully

negative. Red blood count, 5,100,000; white blood count, 7,000; Hb, 77 per cent. The conclusions from a complete blood examination were that there was no suggestion of any leucemic process; there was a mild anemia due to lowered hemoglobin concentration and small cells. Calcium in the blood normal on two examinations.

The roentgen examination showed typical appearance of marble bones affecting all the bones of the body.

In the Proceedings of the staff meetings

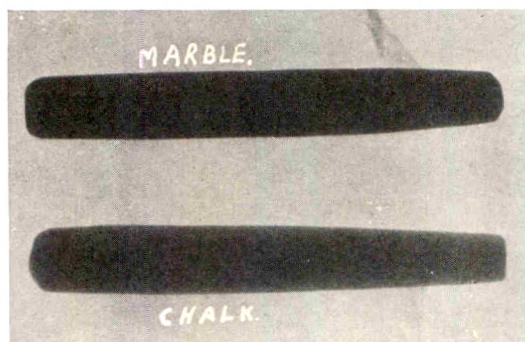


Fig. 5. Roentgenogram of a piece of chalk and a

marble bones is that not all the bones at all points develop the marble appearance. For instance, in my own adult case the upper end of the fibula appeared normal while the rest of the fibula had the marble appearance. Again, the commencement of the process is most evident where healing rickets is most evident, viz., at the ends of the diaphyses. In one of my early cases the condition in the upper end of the

German writers is the fractures found in marble bones of young people. None of my young cases showed any fracture and my adult case had only one fracture. The fractures take place in the bone where it has developed its full marble appearance and it is easy to understand why the fractures occur when you know the bone has grown chalky in consistence and has

like formations running in the longitudinal axes of the bones. Beyond these areas the shaft of the bones is composed of relatively normal appearing outer cortex and inner cancellous area. Nevertheless, even here in the cancellous tissue there is a central, more compact appearing zone and evidence of extension of the column formation described above.

*Microscopic Examination.* Section taken so as to include epiphysis, epiphyseo-diaphyseal line and diaphysis presents the following picture: the epiphysis shows relatively normal appearing cancellous bone composed of spicules with very little enclosed cartilage. Between the spicules there is a large amount of relatively hemorrhagic myeloid tissue containing considerable fibrillar matrix. As one approaches the epiphyseo-diaphyseal line there are greater inclusions of cartilage in the bony spicules. The line varies considerably in thickness, showing a firmer, lighter staining, more compact area of cartilage towards the epiphysis and a more cellular cartilaginous zone which varies considerably in thickness towards the diaphysis. The histological structure of the diaphysis is distinctly different from that of the epiphysis. It impresses one as being fundamentally calcified cartilage in which are smaller and larger irregular open spaces. These open areas compose less than 25 per cent of the total structure and are lined

zone of compact bone of considerable thickness is present beneath the periosteum.

*Anatomical Summary:* *Albers-Schönberg's disease (marble bones).*



FIG. 6. Section of the normal bone of the epiphysis from Case IV showing spicules of true bone and myeloid tissue (low power).







2. The earliest stage of development is best seen at the lower end of the diaphysis of the femur and upper end of the diaphysis of the tibia and humerus.

3. The ring shadows of the carpal bones and iliac bones are early indications of marble bones elsewhere.

4. Marble bones resemble marble only in their roentgenographic appearance. The actual bones are more like chalk in consistence and therefore fracture easily. The term "chalky bones" rather than "marble bones" would better describe the condition.

5. In 4 early cases at the ages of five, eight, eleven, and fourteen, the hand of

12. SCHMIDT, M. B. Ueber osteosklerotische Anämie und Albers-Schönberg'sche Krankheit. *Beitr. z. path. Anat. u. z. allg. Path.*, 1927, 77, 158-173.
13. SEAR, H. R. Case of Albers-Schönberg's disease. *Brit. J. Surg.*, 1927, 14, 657-660.
14. VAN DORP-BEUCKER ANDREAË, D. Roentgen-ray pictures of osteopathia condensans disseminata in patient with abdominal tuberculosis taken one and one-half years after recovery. *Nederl. Tijdschr. v. Geneesk.*, 1928, 1, 1012-1014.
15. ZADEK, I. Osteosklerotische Anämie. *Klin. Wchnschr.*, 1928, 7, 1848-1851.

## DISCUSSION

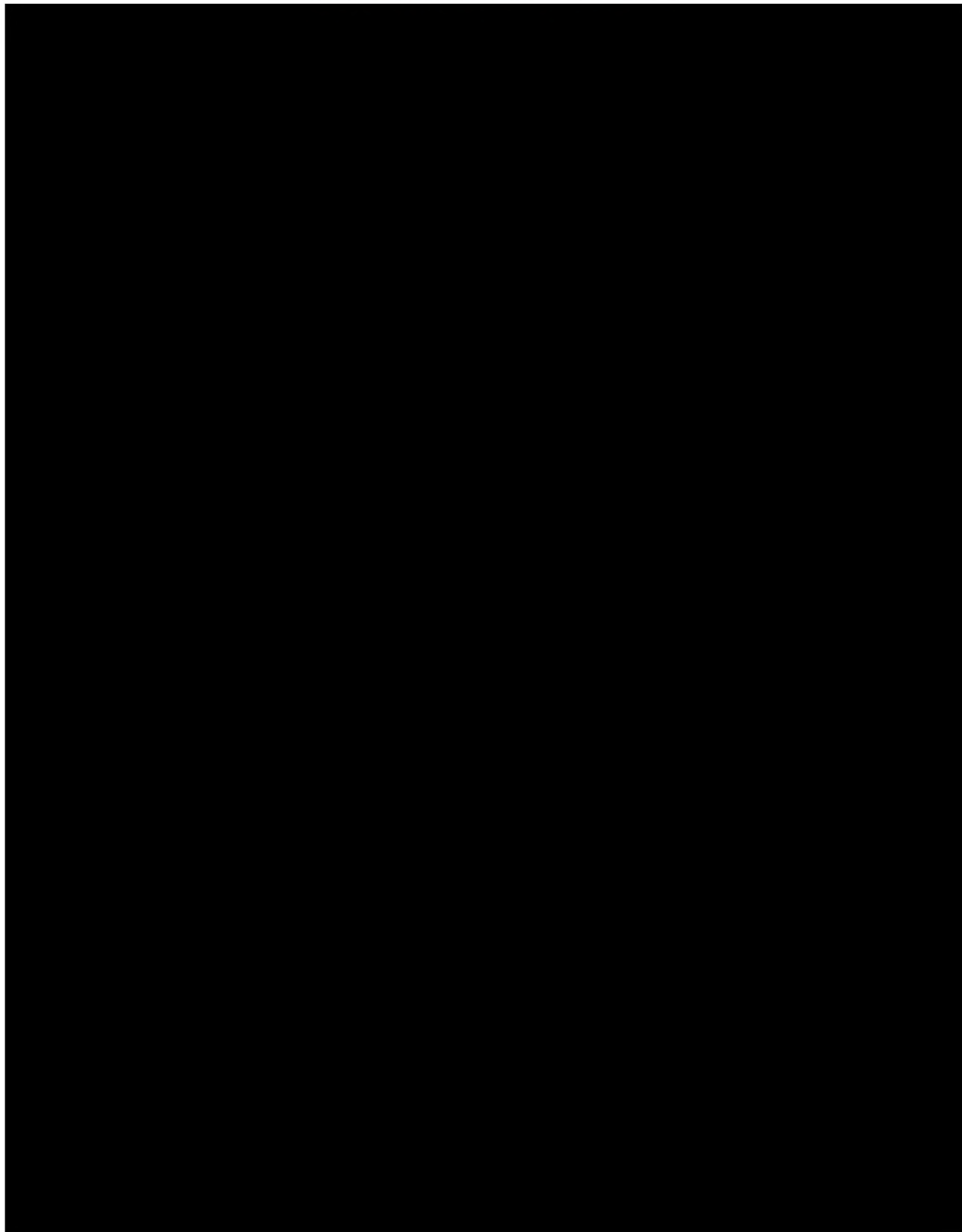
DR. RALPH S. BROMER, Philadelphia. I would like to ask Dr. Pirie whether he knows of any alteration or peculiarity of diet in the previous history of these cases. Dr. Pancoast has told me that he has observed a case of overfeeding of irradiated cod-liver oil. This overfeeding resulted in a very dense and comparatively speedy bone formation. In other words instead of the usual dense appearance of the bones in healed rickets, an overproduction of dense bone was obtained and it was recommended that the feeding of the irradiated cod-liver oil be discontinued. Possibly too much of one vitamin factor in the diet might be a contributory cause of this disease. If the blood calcium in these cases was high and if the calcium content of the bones, analyzed after autopsy was high, I should think that possibly the diet factor might be considered in the etiology of the condition.

about diet and blood calcium and calcium content of the bone I can answer to a certain extent. I think that diet can have very little to do with it because these children were treated just as other children. They went to school, and as far as I could find out, they were normal. They were fairly intelligent children, slightly under-developed: the oldest one was beginning to get slightly anemic from the amount of involvement of the medulla of the bone. The blood calcium was twice investigated in the mother with fully developed marble bones, and we found it normal in both examinations.

I know the Germans have described an increase of blood calcium. It is what one would expect, but our results on two occasions gave no increase in the blood calcium. I had a piece of this marble bone analyzed and found that in weight the calcium was normal and corresponded with normal bone; normal bone is 28 to 29

AUGUST, 1930

## THE UNCOILED AORTA



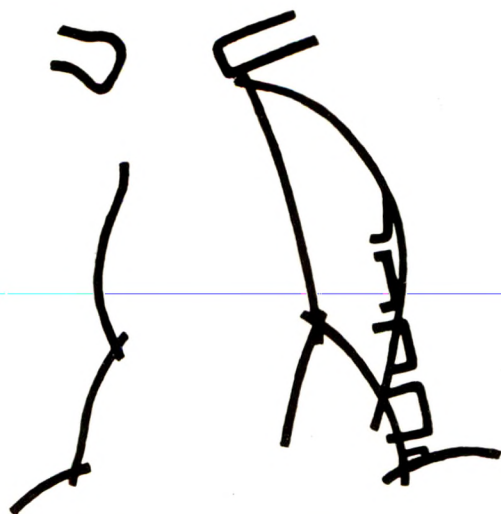


FIG. 1c. Diagrammatic outline of Figure 1b.

age periods seem essential to an understanding of the roentgen manifestation of the arteriosclerotic aorta:

We must differentiate between an ascending period, a summit, and a descending period in the life of the vessel. The first is characterized by an equal increase of all the tissue elements of the vessel wall. In the second, the artery retains its form more or less. In the third there commences the progressive dilatation of the vessel

very slightly. The great elasticity of the aorta is therefore entirely lost in the course of a lifetime. On the other hand, in old age there is apparently a marked increase in the elastic resistance. While the isolated aorta of a thirty year old adult can easily be stretched several centimeters, it is practically impossible to do this with the aorta of an individual in his sixth or seventh decade. Wherein lies the loss of this perfect elasticity and this striking increase of elastic resistance? The loss of perfect elasticity must be dependent on a physical alteration of the elastic tissue of the vessel. It is due to the change which the elastin undergoes with age, a phenomenon which is manifest wherever there is elastic tissue, in the bronchi, the skin, etc. The overstretching of the vessels under the continuous load of the circulating blood would probably be much greater were it not for the fact that the intima of the aorta in particular, under constant longitudinal tension, becomes with increasing age, invaded with more and more connective tissue. This connective tissue possesses very slight elasticity, but has, on the other hand, a great elastic resistance. This explains the fact that the strength of the vessel wall remains almost the same or even increased in spite of the progressive overstretching which it undergoes. It is the uniform thickening of the entire intima with connective tissue that is



traction. A contracted artery relaxes at 50°  
to 62° C. and its temperature remains the

marked curvature at the base of the aorta.

arch limbs (the former more than the latter) and tortuosity (lordosis). The measurements simply aid in expressing this phenomenon.

Figures 2*a* and 2*b* are inserted because they so beautifully demonstrate the relation of the aortic arch and the pulmonary artery in the left anterior-oblique position.

The sclerotic aorta seems to be more dense than the normal adult type since it offers greater opportunity for contrast.

But it is well to state here that as a criterion for the determination of a pathologic aorta, it is very hazardous and ephemeral.

#### SYPHILIS

Let us first renew our knowledge of the syphilitic aorta through the splendid description of Longcope:<sup>4</sup>

Microscopically the earliest lesions which may be definitely recognized show that all three of the main coats of the aorta are involved. The adventitia shows small accumulations of small

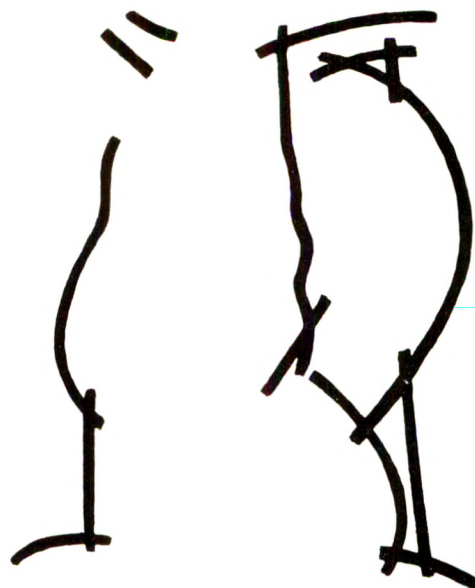


FIG. 4*c*. Diagrammatic outline of Figure 4*b*.

round cells about the vasa vasorum and the intima of both arteries and veins may be thickened. Minute blood vessels extend into the media, and are surrounded along their courses by accumulations of plasma cells, small round cells and epithelial cells. Slight breaks in the elastic tissue are observed in Weigert's stain. The cells of the intima are proliferated and heaped up to form a projection from the inner surface of the vessel.

In the more extensive lesion, the perivascular infiltration of the adventitia is very pronounced.

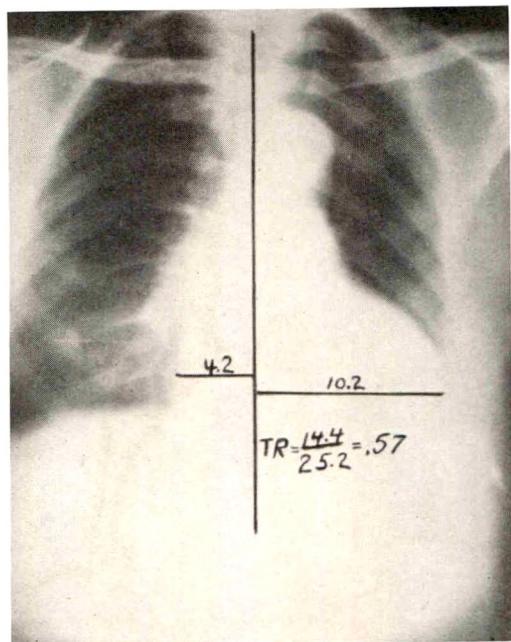
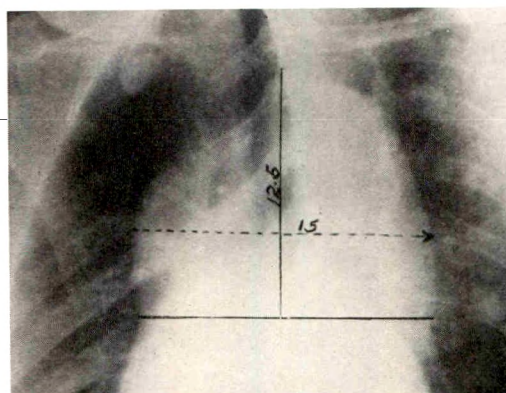


FIG. 5a. The aorta in hypertensive heart disease. Teleroentgenogram of the chest of a patient, aged fifty-six; blood pressure, 220/120; Wassermann reaction, negative; rough systolic murmur over precordium and failure of the congestive type. Note the horizontal position of cardiac shadow and exaggeration of the superior portion of the left ventricular arc.

The third characteristic picture appears to represent a later stage of the process, and shows a scarred distorted vessel wall almost unrecognizable as such with perhaps complete destruction of all three coats of the artery. Small foci of necrosis surrounded by connective tissue, partly vascularized and infiltrated with varying numbers of plasma cells and small round

Figures 3b and 3c demonstrate the type of uncoiling usually observed in a syphilitic aorta. In this case if one employs as a criterion of dilatation a convexity of the supracardiac shadow at the base beyond the right auricle in the frontal view, there would be difficulty in establishing this diagnosis. The obliteration of the aortic knob noted here by some authors finds its explanation in the aortic uncoiling.

Figures 4b and 4c represent a case of tremendous uncoiling. The marked associated elongation and tortuosity suggest the changes that take place when general syphilitic involvement of the aorta is combined with extensive sclerosis. In such cases, one would expect to find the convexity (lordosis) described in the preceding paragraphs. Occasionally one observes patients with syphilitic aortitis without uncoiling. Such cases are to be expected in syphilitic aortitis of short duration. It





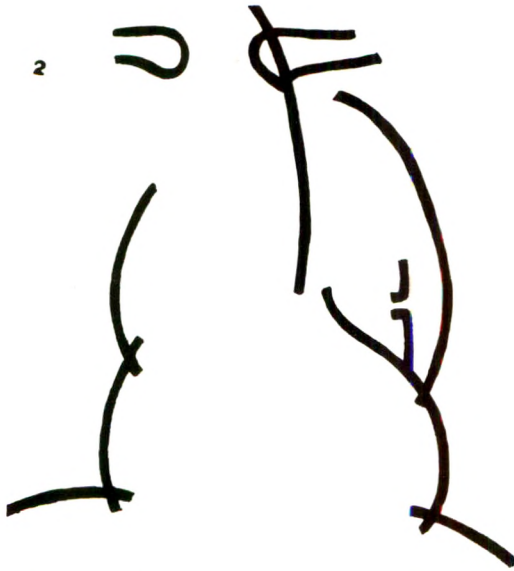


FIG. 5c. Diagrammatic outline of Figure 5b.

would be interesting to observe such patients with this method over a period of years to note the uncoiling.

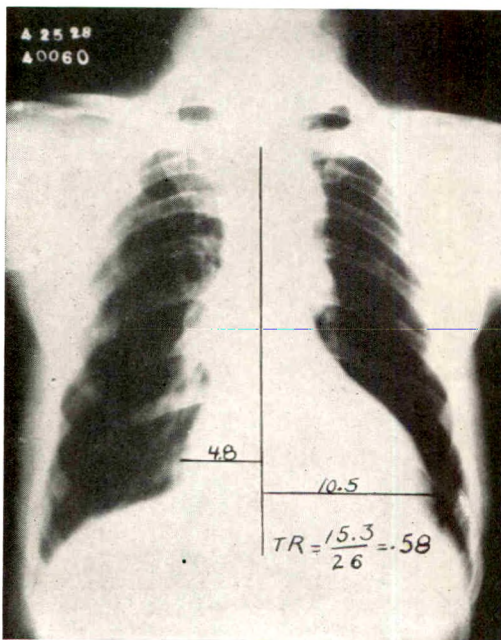


FIG. 6a. The aorta in hypertensive heart disease when combined with arteriosclerosis. Teleroentgenogram of the chest of a patient, aged seventy-two; blood pressure, 180/98; no cardiac failure. The heart is slightly oblique with exaggeration of the superior portion of left ventricular arc.

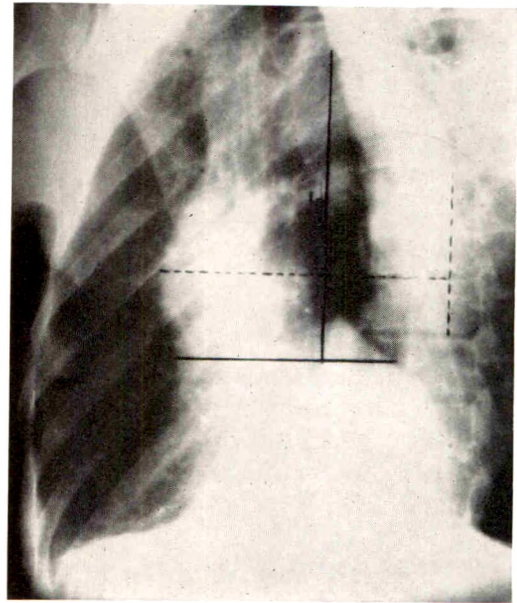


FIG. 6b. Left anterior-oblique view. Note the appearance of uncoiling of the typical sclerotic aorta, i.e., elongation and tortuosity (lordosis); the increase in the longitudinal measurement is more marked than in the transverse.

#### HYPERTENSIVE HEART DISEASE

Aschoff<sup>2</sup> described the aortic changes in hypertensive heart disease as follows:

Hypertonia, whether primary or secondary to an arteriosclerosis of the kidneys never leads

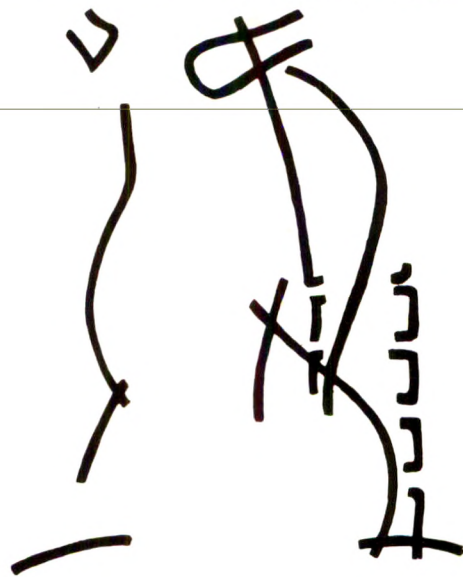
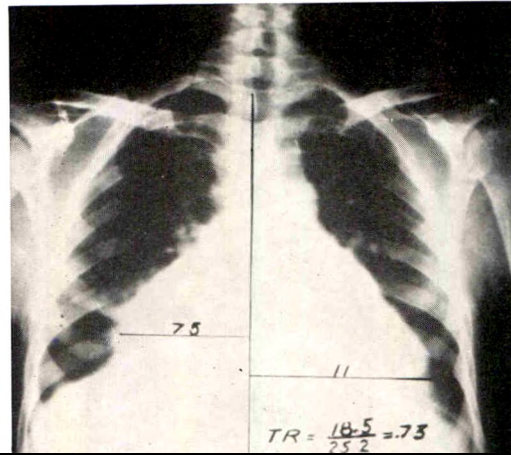


FIG. 6c. Diagrammatic outline of Figure 6b.

to an atheromatosis, but to a true hypertrophy of the entire aortic system with involvement of all the coats, while the real atheromatosis of the aorta is primarily a disease of the intima.

Figure 5a presents a typical manifestation of the aortic changes in a patient with hypertensive heart disease. The pathologic uncoiled aorta is at once demonstrated in the left anterior-oblique position. Note the superiority of this view to the frontal in demonstrating alterations in the aortic tube. Figure 6a reveals the typical type of sclerotic aorta associated with hypertension. The sclerotic aorta is usually associ-



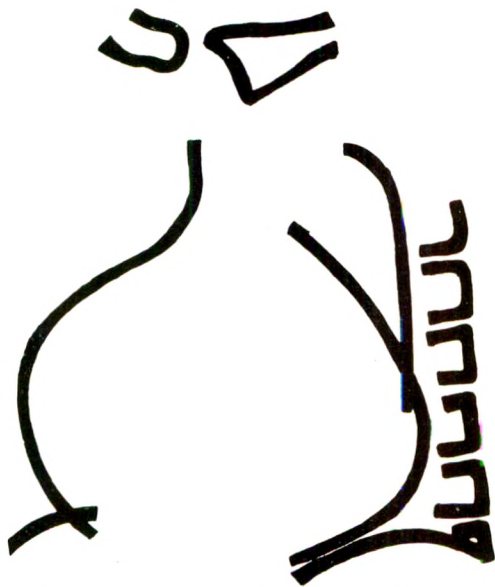


FIG. 7c. Diagrammatic outline of Figure 7b.

comparison of the findings in such a patient with those of the syphilitic group revealing similar cardiac configuration and involvement of the aortic valves, will reveal a distinct pathologic uncoiling of the aorta in the latter. This is confirmatory of the observations made by Holmes,<sup>3</sup> that no dilatation of the aorta is noted in rheumatic disease involving the aortic valves.

On the other hand, one finds in the syphilitic group, patients with enlargement of the heart confined to the region of the left ventricle and no pathologic uncoiling of

hypertensive heart disease, and syphilis. It must be clearly understood that the roentgen appearance of the uncoiled aorta, per se, will not differentiate between these three etiologic factors. The cardiac configuration may be of some aid. The determination of a pathologic uncoiled aorta is but the positive demonstration of a volumetric change. As such, I believe it will prove to be a distinctly valuable roentgen contribution to our methods of physical diagnosis and should be of great aid where accuracy is desired. It may be after many serial observations have been made, that it will prove of prognostic import, possibly in the manner of the electrocardiograph in cardiac disease.

In the final analysis, at the risk of stating a platitude, the roentgen observations should always be correlated with those clinically determined.

#### SUMMARY

1. Four types of heart and aortic disease are discussed, viz., arteriosclerotic, syphilitic, hypertensive, and rheumatic.
2. The character of the uncoiled aorta in these conditions is described and illustrated.
3. The aorta may be pathologically uncoiled as a result of senile sclerosis, hypertensive heart disease, and syphilis, but the roentgen appearance of the aorta, per se,



## THE TREATMENT OF ANGINA PECTORIS BY PARAVERTEBRAL SHORT WAVE RADIATION\*

By MARCY L. SUSSMAN, M.D.

*X-ray Department, Massachusetts General Hospital*

BOSTON, MASSACHUSETTS

THE roentgen treatment of angina pectoris at this hospital was suggested by the recent work of Mixer and White<sup>20</sup> who inject the stellate and upper dorsal sympathetic ganglia with alcohol. This work is based on the theory that the pain of angina pectoris is transmitted through rami communicantes to the spinal nerve roots, and that the greater part of these painful sensations are transmitted through the upper dorsal roots. Swetlow<sup>29</sup> believes that the somatic representation of anginal pain on the surface of the body indicates the roots through which these painful sensations pass. Dr. Holmes, therefore, suggested the possibility of influencing these ganglia by roentgen radiation, in the hope of achieving the good results obtained by injection or sympathectomy, without the disadvantage of an operative procedure.

A review of the literature showed that paravertebral irradiation had already been used in the treatment of angina pectoris. The earliest reference is to Groedel,<sup>13</sup> in 1923, details of which are not available. There are two reports in the American literature: Ecker,<sup>10</sup> in 1927, and Torbett,<sup>32</sup> in 1929, each of whom treated one case with marked improvement. The most extensive work is reported from France where a group consisting of Barriau, Nemours-Auguste and Lian have made several communications.<sup>4,5,17,21</sup> They regard angina pectoris as a crisis of the cardio-aortic plexus, and irradiate the upper segments of the spinal cord when all other physical methods fail to give relief. The technique is one skin unit dose given over a period of three or four weeks to the cervical segments of the spinal cord in a dorsoventral position, and to the upper dorsal segments

in the ventrodorsal position, the rays being directed through the left anterior chest wall. In their communication in 1928, they reported having treated 30 cases over a period of one year and state that the usual result has been a considerable decrease in the intensity and frequency of the attacks of angina pectoris beyond that to be expected spontaneously, and that the effect has continued for at least several months. In 1929 they reported 54 cases, all grave and chronic, which had been unsuccessfully treated by other means; 31 were completely relieved of pain; there was amelioration of the pain in 8; there was no effect in 5; 1 was aggravated and 6 died within the duration of observation. The last 7 cases are given in detail. All 6 who died were persons over sixty-six whose deaths may well have been incidental and not related to treatment. A letter from Vienna<sup>5</sup> in September, 1929, reports 7 further cases in which the crisis and all its concomitant symptoms ceased—even the arrhythmia improved.

Arrillaga<sup>3</sup> of South America has also used this method of treatment. He uses short wave therapy, and in the latter part of 1928 reported 8 cases which were successfully treated. One was treated in November, 1926, with complete subsequent relief. The other 7 cases have remained well for eight to twelve months. He believes that the effect of the radiation is on the stellate ganglion, the third cervical sympathetic ganglion and their rami communicantes, with general lessening of nerve excitability.

The advisability of a procedure which removes the anginal pain may be questioned and must be seriously considered since

\* Read at the Radiological Conference (New England Roentgen Ray Society, New York Roentgen Society, Philadelphia Roentgen Ray Society, Radiologists of Washington, D.C., Radiologists of Baltimore, Md.), Boston, Mass., Jan. 24-25, 1930.



the warning to the patient of his condition is removed. The same objection is present, of course, with alcohol injection or sympathectomy, and to a greater degree. Roentgen radiation probably has no effect on the patient's cardiac condition. Schweitzer has reported myocardial degeneration following irradiation of the chest, but he used large doses—two erythema doses front and back, and one-half erythema dose to each axilla. Thibaudeau and Mattick<sup>31</sup> report 10 cases which received irradiation over the chest for malignancy. The heart muscle showed fibrosis which seemed rather more diffuse than in the controls, hyaline and fatty changes, and a loss of definiteness in the cross striations. There was an increase in the fluid content of the heart muscle with separation of the muscle fibers by a poorly staining, loosely woven alveolar tissue presenting a somewhat dropsical appearance. Davis<sup>8</sup>, however, found no essential change. Emery and Gordon<sup>11</sup>, and Warthin and Pohle<sup>33</sup> experimentally found no gross nor microscopic changes in the hearts of their animals. Laubry<sup>16</sup> is the outstanding objector to the method; he says that it has been tried without result for years by many radiologists, but fails to give references. He further claims to have seen 3 cases that Nemours-Auguste had treated that were made worse. Chaperon<sup>6</sup>, too, has emphasized the fact that there are dangers associated with the method.

That angina pectoris can be relieved, in certain cases, by irradiation seems apparent from the literature, and from the work at this hospital, but an explanation of the mechanism presents many difficulties. Angina pectoris is a clinical syndrome

factors which may be operative in causing an attack, in the aorta, coronaries, ~~myocardium~~ or nervous system.

It seems desirable to attempt to answer Dr. Holmes' original suggestion: "Can the sympathetic ganglia in the upper dorsal region be influenced by roentgen radiation?" Desjardins,<sup>9</sup> in 1927, made the following observations:

The analgesic property of roentgen rays is a matter of daily observation in the radiotherapy of benign and malignant tumors. In fact, abolition or diminution of pain is often the first sign of the effect of the rays noted by the patient and this may occur quite early, before any change in the size of the tumor can be perceived. Perhaps the mechanism of the analgesia is relief of pressure on the sensory nerves by destruction of the tumor cells in tumors, or lymphocytes in inflammations. However, the relief of perianal pruritus, neuralgia, the spasmodic manifestations associated with certain traumatic injuries of nerves lead one to the conclusion that there must be a true specific action on nerve cells. There is evidence that nerve cells, which of all the cells of the body are the most resistant to radiation so far as functional or organic damage is concerned, are acted on in a specific manner and their irritability diminished by radiation.

Histopathological findings on the sympathetic after roentgen or radium treatment, are seldom recorded. Terplan<sup>30</sup> found in sympathetic ganglia of malignant tumors small changes in some nerve tissue, namely, chromatolysis, vacuolization, loss of nuclei, plasma cells with large granules or too small nuclei. Increase in the histiocytes of the brains of irradiated mice has been noted. There seems to be a definite effect upon the nerves supplying blood vessels. The work of Richter<sup>27</sup> indicates that dilator fibers are stimulated by weak ra-

by present methods on nerve tissues, but notable changes are found in the blood vessels. Danysz,<sup>7</sup> London<sup>18</sup>, Obersteiner<sup>22</sup>, Alquier and Faure-Beulieu<sup>2</sup> found various degrees of hemorrhage and round cell infiltration around the blood vessels but the nerve cells appeared unaltered. Pendergrass, Hayman, Houser and Rambo<sup>23</sup> in studying the effect of radium on normal brain tissue showed the same pathological processes. In addition, they call attention to an increase in the weight of the treated hemispheres, the increase seeming to bear more relation to the time the dog lived after the operation than to the dose of radium given. The increase in weight was explained as being due to edema.

There are very few recorded impressions

diation, while not yet sufficiently extensive, has presented no new material.

Experiments on the effect of irradiation upon the physiological properties of nerves are also rather sparse. Redfield, Redfield and Forbes,<sup>26</sup> reporting on the action of beta rays, use very much larger doses than are clinically possible. Some statements, however, are perhaps important, to our subject. They say, "Intense radiation with beta rays destroys the functional capacity of a nerve trunk. There may be a marked latent period between the termination of the radiation and the loss of function, the latent period increasing in length as the quantity of radiation decreases." This phenomenon, they say, suggests two distinct processes: the first, some change produced directly by the radiation, which may

*in situ*, does not cause miosis as happens with sympathectomy, nor does it have any appreciable effect on the pulse rate. These observations are being continued, each case being followed by electrocardiograms, and sensory status examinations, where possible. Results on the motor function of the sympathetic cannot be directly transferred to the problem of pain, however, although there must be great similarity. Ransom,<sup>25</sup> for example, states that pain travels along non-myelinated fibers, while it is Adrian's opinion<sup>1</sup> that the fibers from the various receptors may differ somewhat in their time relations, but the fundamental

4 mm. celluloid filters; 50 cm. target skin distance—effective wave length,  $0.166\text{\AA}$ ; 4 ma.; field  $10 \times 20$  cm., arranged so that the 20 cm. length extends along the posterior surface of the dorsal vertebrae from the seventh cervical vertebra, caudally. The vertebral spines are in the midline of the field. In one or two cases, where the anginal pain has been unusually low, a second field covering the lower dorsal vertebrae has been used. The dose has varied between 400 and 500 ma-min. (800 R) given in three divided doses at one to two day intervals. In 4 cases this was repeated one month after the first

which an attempt to inject the right dorsal ganglia on three different occasions failed to yield relief. In November, therefore, he was having three or four right-sided anginal attacks a day, when resting; six to ten on exertion. He received 400 ma-min. over the upper dorsal vertebrae, in the latter part of November, 1929. He returned in the middle of December reporting that the attacks were less frequent but just as severe. The pain was now largely in the hypochondrium. It was therefore thought desirable to irradiate the lower dorsal ganglia. He received 360 ma-min. over this region. He reported on March 4, 1930, stating that he had had no severe attacks since this last treatment, and except for a soreness about the right nipple, he was completely relieved.

One patient died during the course of observation—a man, aged sixty-two with coronary artery disease who had been complaining of epigastric distress for four months, interpreted as anginal in character. For two weeks, the pain had been unusually severe, attacks occurring three or four times a day. He received 360 ma-min. over the upper dorsal vertebrae. Six days after completion of treatment he developed what clinically appeared to be a typical attack of coronary thrombosis and died two days later. Permission for autopsy could not be obtained. It does not seem at all reasonable to ascribe this death to treatment.

These treated cases are entirely too re-

cent to warrant any definite conclusions and they are too few in number. Only extended observation on a large series of cases will provide satisfactory conclusions as to the value of roentgen radiation in the treatment of angina pectoris. Certainly our results warrant the continuation of the method. With the active cooperation of the various departments, particularly the Cardiac Clinic, we hope to accumulate sufficient accurate data to gauge its value.

#### SUMMARY

The literature on the treatment of angina pectoris by roentgen radiation is reviewed.

A possible mechanism for the relief of pain is considered.

The literature on the effect of roentgen radiation on the nervous system, particularly as it relates to its analgesic action, is reviewed.

Experiments on the effect of roentgen radiation on the sympathetic nervous system are reported.

A preliminary report is made on the treatment in this clinic of 16 cases of angina pectoris by paravertebral irradiation. Six were almost completely relieved; 5 moderately improved; one has died; 4 have not yet returned for observation.

#### REFERENCES

1. ADRIAN, E. D. *The Basis of Sensation*. W. W. Norton, New York, 1928.
2. ALQUIER and FAURE-BEAULIEU. L'action du radium sur les tissus du névraxe. *N. iconog. de la Salpêtrière, Par.*, 1909, 22, 109-113.
3. ARRILLAGA, F. C. L'angine de poitrine; son traitement par la radiothérapie profonde. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1928, 52, 949-953.
4. BARRIEU and NEMOURS-AUGUSTE. Technique et résultats du traitement de l'angine de poitrine par la radiothérapie. *Compt. rend. Acad. d. sc.*, 1928, 186, 545.
5. BARRIEU and NEMOURS-AUGUSTE. Paris letter. *J. Am. M. Ass.*, 1929, 92, 910; Vienna letter. *Am. J. Roentgenol. & Rad. Therapy*, 1929, 22, 268.
6. CHAPERON. Au sujet de la radiothérapie dans le traitement de l'angine de poitrine. *Bull. et mém. Soc. de radiol. méd. de France*, 1929, 17, 55-57.
7. DANYSZ, J. De l'action pathogène des rayons et des émanations émises par le radium sur différents tissus et différents organismes. *Compt. rend. Acad. d. sc.*, 1903, 136, 461-464.
8. DAVIS, K. S. Intrathoracic changes following x-ray treatment; a clinical and experimental study. *Radiology*, 1924, 3, 301-322.
9. DESJARDINS, A. U. Analgesic property of roentgen rays. *Radiology*, 1927, 8, 317-324.
10. ECKER, L. C. Angina pectoris; report of cases treated with roentgen ray. *Radiology*, 1927, 8, 98-103.
11. EMERY, E. S., JR., and GORDON, B. Effect of roentgenotherapy on the human heart. *Am. J. M. Sc.*, 1925, 170, 884-887.
12. GORDON, B., STRONG, G. F., and EMERY, E. S.



- cordium on the heart size, heart mechanism and myocardium of rabbits. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1924, 11, 328-330.
13. GROEDEL, F. in Saltzmann. Röntgenbehandlung innerer Krankheiten. J. F. Lehmann, 1923, p. 209.
  14. HORSLEY, VICTOR, and FINZI, N. S. The action of filtered radium rays when applied directly to the brain. *Brit. M. J.*, 1911, 2, 898-900.
  15. LANGER, HEINZ. Roentgen rays and the autonomic nervous system. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1927, 18, 137-145.
  16. LAUBRY, C. Discussion. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1928, 52, 1038.
  17. LIAN, C., BARRIEU, R., and NEMOURS-AUGUSTE. Technique et résultats de la radiothérapie dans l'angine de poitrine. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1928, 52, 1030-1041.
  18. LONDON, E. S. Zur Lehre von den Becquerelstrahlen und ihren physiologisch-pathologischen Bedeutungen. *Berl. klin. Wchnschr.*, 1903, 40, 523-524.
  19. McCRAE, T. Angina pectoris; is it always due to coronary artery disease? *Am. J. M. Sc.*, 1930, 179, 16-21.
  20. MIXTER, W. J., and WHITE, J. C. Alcohol injection in angina pectoris. *Ann. Surg.*, 1929, 89, 199-202.
  21. NEMOURS-AUGUSTE, and BARRIEU, R. Sur le traitement de l'angine de poitrine par la radiothérapie. *Bull. et mém. Soc. de radiol. méd. de France*, 1929, 17, 27-31.
  22. OBERSTEINER, O. Die Wirkungen der Radiumbestrahlung auf das Nervensystem. *Wien. klin. Wchnschr.*, 1904, 17, 1049.
  23. PENDERGRASS, E. P., HAYMAN, J. M. JR., HOUSER, K. M., and RAMBO, V. C. Effect of radium on the normal tissues of the brain and spinal cord of the dog. *AM. J. ROENTGENOL.*, 1922, 9, 553-569.
  24. POLÁK, E. Über die Wirkung von Radiumemanation auf die Gefässe. *Acta radiol.*, 1928, 9, 169-205.
  25. RANSON. Quoted by Adrian, ref. 1.
  26. REDFIELD, E. S., REDFIELD, A. C., and FORBES, A. Action of beta rays of radium on excitability and conduction in nerve trunk. *Am. J. Physiol.*, 1922, 59, 203-221.
  27. RICHTER. Quoted by Strauss, O., and Rother, J. Strahlenwirkung auf das vegetative nervensystem. *Strahlentherapie*, 1924, 18, 37-63.
  28. SWAN, M. B. R. Study of immediate effects of x-rays on functions of certain tissues and organs. *Brit. J. Radiol.*, 1924, 29, 195-220.
  29. SWETLOW, G. I. Paravertebral alcohol block in cardiac pain. *Am. Heart J.*, 1926, 1, 393-412.
  30. TERPLAN. Quoted by Langer, ref. 15.
  31. THIBAudeau, A. A., and MATTICK, W. L. Histological findings in hearts which have been exposed to radiation in the course of treatment of adjacent organs. *J. Cancer Research*, 1929, 13, 251-259.
  32. TORBETT, J. W. X-ray treatment of angina pectoris and peribronchial adenopathy. *Am. J. Phys. Therapy*, 1929, 6, 272.
  33. WARTHIN, A. S., and POHLE, E. A. Effect of roentgen rays on the heart; microscopic changes in heart muscle of rats and rabbits following single exposure. *J. Am. M. Ass.*, 1927, 89, 1825-1829.
  34. WARTHIN, A. S., and POHLE, E. A. Effect of roentgen rays on the heart; microscopic changes in heart muscle of rats and rabbits following series of exposures. *Arch. Int. Med.*, 1929, 43, 15-34.



## THERAPEUTIC LEAD POISONING\*

By SANFORD WITHERS, M.D.

DENVER, COLORADO

IT IS hoped that this paper will prove of practical importance to those who are using or expect to make use of colloidal lead in the treatment of malignancy. The attempt is made to give the important points in the management of cases of hopeless malignancy in which one expects to produce lead poisoning.

Following this will be reviewed a series of 64 patients who were treated with colloidal lead. In order that the views herein expressed may not seem too heretical, your attention is called to certain recent publications relating to lead therapy by Waters, Colston, and Gay,<sup>8</sup> Ullmann,<sup>7</sup> Soiland, Costolow and Meland,<sup>6</sup> and Knox,<sup>3</sup> These writers (with the exception of Ullmann) have neglected to mention or apparently to take into account, the all-important feature of lead therapy, namely, the mobilization of the lead introduced, either by accident or design, to produce an acute lead poisoning.

There is one thing which stands out more than all others in the use of lead for hopeless malignancies. In order to produce a retrogression of the growth, *it is necessary to produce an acute lead poisoning of*

tion, will usually result in a drop in the hemoglobin estimation and red cell count of 30 to 50 per cent, with typical changes in the red blood cells consisting not only of the classical stippling, but also a much earlier change which gives the affected red cells a bluish cast.

5. The change in the kidneys in the cases of acute lead poisoning is not so prolonged as most writers would have us believe. Acute nephritis accompanied by transient hematuria with large amounts of albumin, and a tendency towards suppression of urine secretion is not at all rare, yet in my series of cases, it has not been troublesome. It is not frequently found that the patient's phenolsulphonphthalein excretion increases noticeably in percentage after the acute lead poisoning.

The chief problem in the use of colloidal lead is to find some reliable method for the production of acute lead poisoning in these cases which will surely and rapidly mobilize the lead stored in the body or which will prepare the patient to receive colloidal lead so that it will not be stored in the alkali reserve. I believe that the results of this treatment could be greatly improved







tion of the stored lead was evidenced, each of these patients having received over 500 mg. of lead. When mobilization did take place, it was believed to be due to poisoning by ammonium chloride.

lead. These writers have called attention to the fact that the increased excretion of stored lead in the body may be brought about by the injection of 10 to 20 units of parathormone per day over periods of

#### CANCER OF THE PROSTATE

Case No.	Cell type	Previous treatment	Lead mg.	Date	Mobilization	Other treatment	Died	Living	Remarks
8	?	Two operations	500+	1-'27	+	X-Ray	1-15-28		Cause of death unknown
22	?	Excision and radium	280	3-'27	Incidental +++	X-Ray 2800 ma-min.		6-1-29	Doing well
						X-Ray			

was given 300 units of parathormone in ~~three~~ days without a mobilization of the lead or producing hypercalcemia.

(6) A severe mobilization can be produced, however, by excluding carbohy-

saccharin. This in 2 cases produced a mobilization which was almost uncontrollable and which broke down the sarcoma which was metastatic to the liver so that the patient died.

#### CANCER OF THE BUCCAL MUCOUS MEMBRANE



tion to a point where the lead will be mobilized.

There are no definite criteria for estimating the degree of mobilization that is taking place, but it is of help to make daily

place when the  $\text{CO}_2$  combining power falls below 45 to 48 volumes per cent and the pH of the urine remains at 5.0 to 5.4 as determined by Sansum's method.

We have made some determinations of

## CANCER OF THE BREAST

Case No.	Cell type	Previous treatment	Lead mg.	Date	Mobilization	Other treatment	Died	Living	Remarks
					Influenza				No reaction seen

as to the degree of mobilization as expressed in pH changes in the blood. I believe, however, that with a refined technique in the hands of a capable technician, direct readings on cooled whole blood can be made before clotting takes place.

I think, however, the problem is more complicated than would seem apparent

Whatever is done, must be done quickly and effectively. Calcium salts have been recommended for this and I have given several patients who were in a state of acute lead poisoning as much as 4 gm. of calcium chloride intravenously per day for three days without noticing the least change for the better in the patient's

CANCER OF THE CERVIX AND UTERUS

CASE No.	LOCATION PRIMARY GROWTH	CELL TYPE	PREVIOUS TREATMENT	LEAD mg.	DATE	MOBILIZATION	OTHER TREATMENT	DIED	LIVING	REMARKS
3	Uterus	Solid Adeno-carcinoma	Excision	496	12-'26	+	None	5-19-27		Masses softened
11	Cervix	Squamous 2	Excision, x-ray and radium	540+	1-'27	++++	None	4-4-27		Lead poisoning, intestinal obstruction?
26	Cervix	Squamous 2	Excision	200	4-'27	Treatment discontinued				Not traced
36	Cervix	Squamous 2	Radium and hysterectomy	300+	9-'27	+	X-Ray 2400 ma.min.	4-1-28		Mass sloughed out
41	Cervix	Squamous 1	Colloidal lead, fulguration	80	1-'28	Treatment discontinued		5-4-28		Weakened from hemorrhage and lead
51	Cervix	Squamous 3	Hysterectomy	108	5-'28	+	X-Ray and radium		6-1-29	Recurrence but good palliation
63	Cervix	Squamous 3	X-Ray and radium	206	12-'28	Intentional ++	None	1-30-29		Hydro- and pyonephrosis
66	Cervix	Squamous 2	Cautery	110	1-'29	Treatment discontinued		3-29-29		

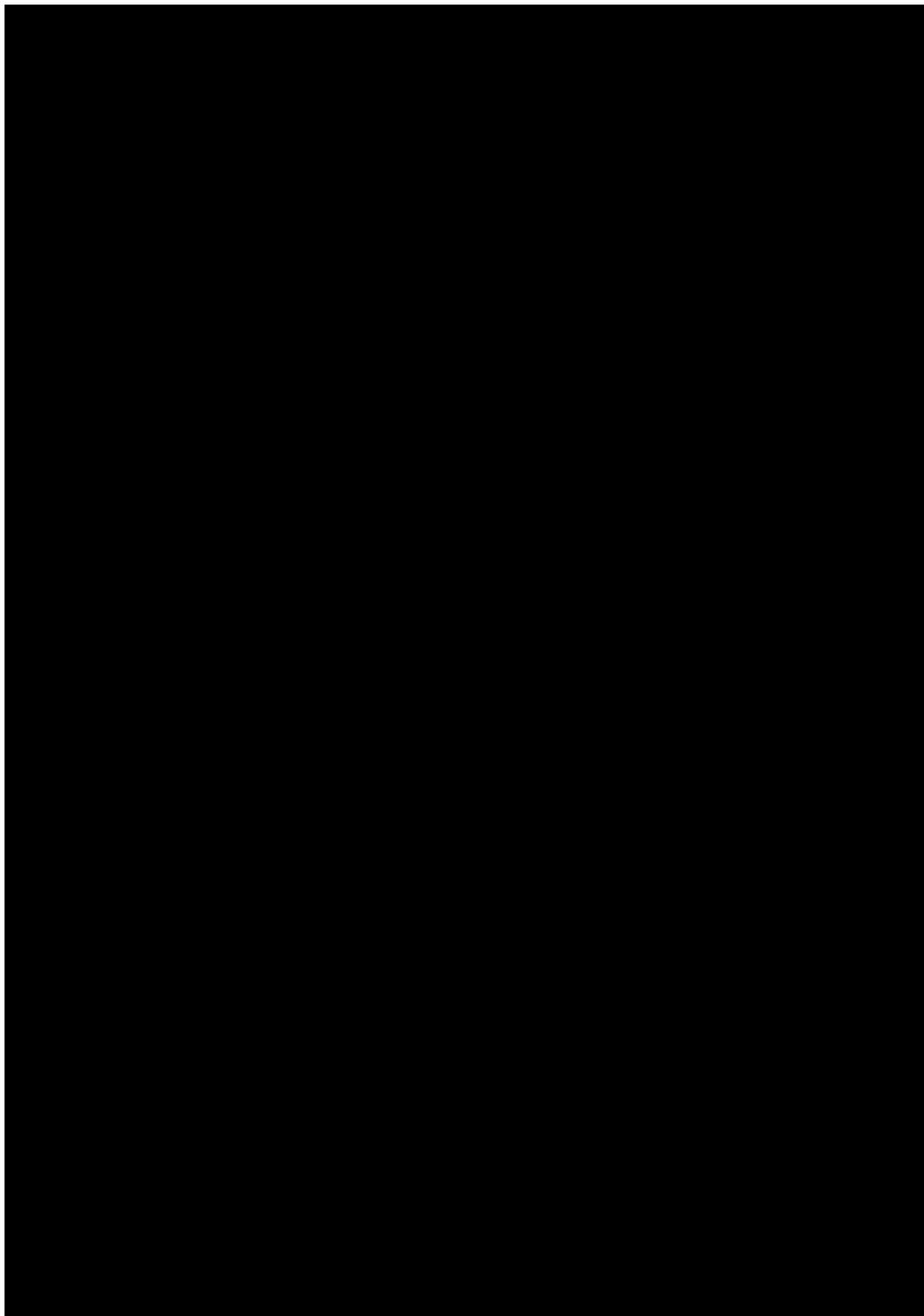
TABLE VI. Of the eight cases treated, 7 were primary in the cervix. None of these cases showed a complete retrogression. The only survivor, Case 51, has developed a mass in the rectovaginal septum which is probably malignant.

and that the lead stored in the body is linked very intimately with the alkali reserve of the body and that mobilization does not take place until the alkali reserve falls to a pathological level.

When mobilization has been accomplished and the patient is reaching a point where you believe that he will probably succumb in the next forty-eight hours, then is the time to demobilize the lead, and combat the acidosis.

However, the intravenous administration of 5 or 6 gm. of anhydrous sodium carbonate will frequently change the patient who is unconscious, definitely moribund, into a comparatively well individual within ten minutes. It is also advisable to give alkalis and glucose per rectum. I have used as high as 1500 c.c. of 5 per cent sodium bicarbonate and 5 per cent glucose every twelve hours until alkalis could be taken by mouth, which is two to

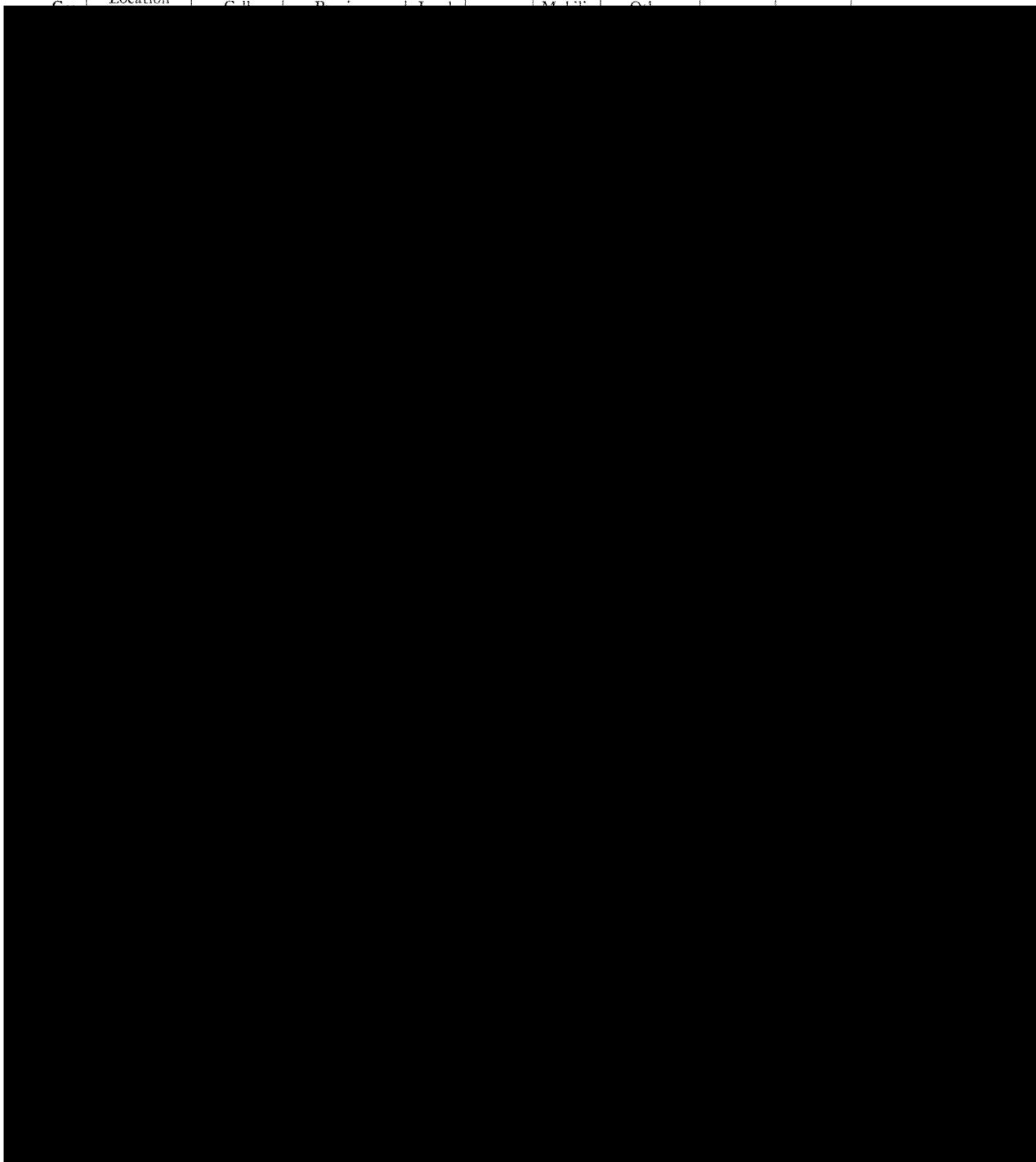




Sections from two of these nodules showed gumma and the patient is alive and well on antiluetic treatment, now more than two years, and has gained 69 pounds. It corrected. One, a lymphosarcoma of the small intestine, was called a carcinoma. In another case a lymphosarcoma of the nasopharynx was called an "epithelioma."

MISCELLANEOUS MALIGNANCY

C	Location	Cell	Reaction	Tissue	Metastasis	Outcome	Remarks				
---	----------	------	----------	--------	------------	---------	---------	--	--	--	--



## SUMMARY

Group	Number Cases Treated	Number Dead	Number Living	Average Months After Treatment	Remarks
Sarcoma	10	6	4	17.2	One not traced
Ovary	10	6	3	17.3	
Prostate	3	1	2	17	One not traced
Gastric	3	3			
Buccal	9	7	1	24	
Breast	8	7	1	21	One not traced
Cervix-Uterus	8	6	1	13	
Rectum-Colon	10	6	3	22.3	One not traced
Miscellaneous	3	2	1	15	
	64	44	16	18.4	4 not traced

TABLE IX. A summary of the 64 cases of malignancy shows that 4 have not been traced, that 44 are dead and that 16 patients, or 25 per cent are alive an average of 18.4 months after treatment.

## SUMMARY

Attention has been called to the following important practical points in the use of colloidal lead:

1. That mobilization of injected lead is essential to obtain favorable results.

2. That the best criteria for estimating the degree of mobilization are determinations of the CO<sub>2</sub> combining power of the blood and the pH of the urine.

3. That there is no satisfactory method of producing mobilization of ingested lead.

4. That the use of large amounts of alkalis by mouth, per rectum, and intravenously, are indicated when rapid demobilization is desired.

5. That a review of 64 cases of hopeless malignancy treated by colloidal lead shows that 16 cases are living an average of 18.4 months after treatment.\*

\* I wish to express my sincere thanks to Dr. W. W. Haggart, Director of the Cancer Clinic of the University of Colorado, and to Dr. John R. Ranson, formerly my associate, for technical help and valuable advice in the treatment of this series of cases.

## REFERENCES

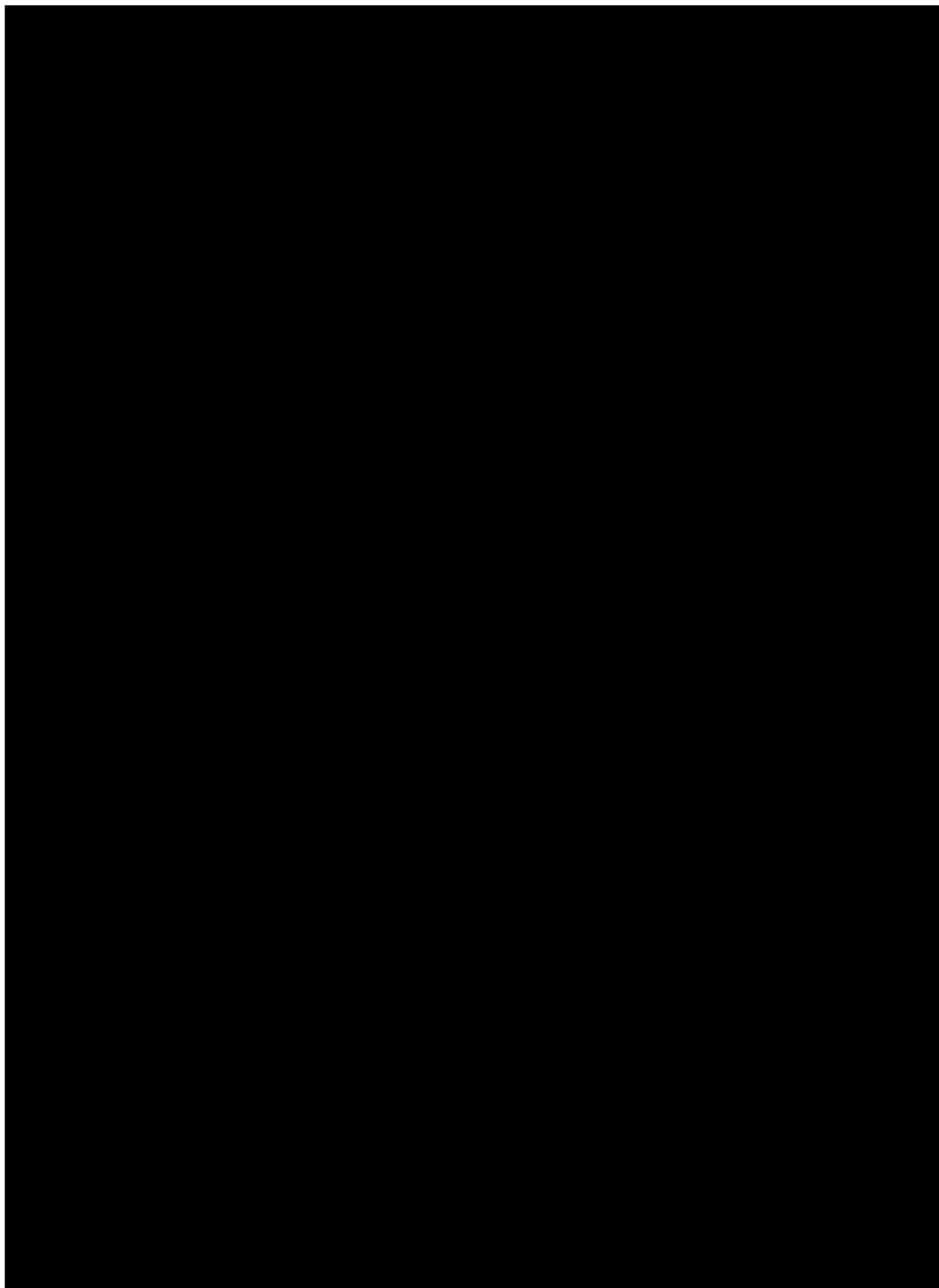
1. AUB, J. C., FAIRHALL, L. T., MINOT, and REZNICKOFF. Lead Poisoning. Williams and Wilkins, Baltimore, 1926.
2. HUNTER, D., and AUB, J. C. Lead Studies. xv. The effect of the parathyroid hormone on the excretion of lead and of calcium in patients suffering from lead poisoning. *Quart J. Med.*, 1926-1927, 20, 123-140.
3. KNOX, LEILA C. Lead therapy. *J. Am. M. Ass.*, 1929, 92, 106-109.
4. KOEHLER, A. E. The effect of acid and base ingestion upon the acid-base balance. *J. Biol. Chem.*, 1927, 72, 99-121.
5. SCHREINER, B. F., and WENDE, R. C. Advanced cancer treated by colloidal lead. *Surg., Gynec. & Obst.*, 1929, 48, 115-118.
6. SOILAND, A., COSTLOW, W. E., and MELAND, O. N. Colloidal lead combined with x-rays and radium in treatment of cancer. *J. Am. M. Ass.*, 1929, 92, 104-106.
7. ULLMANN, H. J. Colloidal lead and irradiation in the treatment of cancer. *J. Am. M. Ass.*, 1929, 92, 18-20.
8. WATERS, C. A., COLSTON, J. A. C., and GAY, L. N. Colloidal lead with high voltage roentgen therapy in malignant disease. *J. Am. M. Ass.*, 1929, 92, 14-18.

## DISCUSSION

DR. EMIL G. BECK, Chicago: I have had no personal experience at all with lead therapy. I wish, however, to comment on the good logic of producing mild lead poisoning in order to destroy the cancer. The results of lead treatment, as shown by Dr. Withers, were good, considering that they represent a group of hopeless cases. I have always contended that if a case is

not cured at the first operation it invariably becomes a hopeless case. Dr. Withers has shown us that of this hopeless group, he kept 25 per cent alive for eighteen months. Thus we may hope to develop a method in which a light lead poisoning so gauged as to arrest the disease may prolong the life of a hopeless case.

PROF. ROBERT T. LEGGE, Berkeley, Calif.: I





## THE RELATIVE VALUE OF RADIUM IN THE TREATMENT OF CANCER\*

By M. J. SITTENFIELD, M.D.

NEW YORK CITY

IN RECENT years there has been a marked awakening of interest concerning the value of radium in malignant diseases, so much so that both here and abroad, activities have been instigated to establish centers where large quantities of radium can be made available. The incidence of neoplastic diseases has increased in sharper outline, as other chronic diseases of not as far-reaching economic importance have gradually lessened. This social problem involves not alone humanitarian aspects, but also presents another phase, which has as yet not been sufficiently stressed. That is, it affects an individual, and indirectly his dependents, at the time of his greatest economic value. This makes it of paramount importance for us as cancer students to realize the want of a specific therapy in this particularly harassing malady.

It is this increasingly evident situation which has prompted me to indicate what appears to me to be the immediate problem. For this reason, it is timely to evaluate radium in the treatment of cancer in relation to the formally accepted and orthodox methods. In the main, this discussion is not offered in the sense of a criticism of either one method or the other, but rather in the form of an unbiased analysis of the results achieved by surgery in its selected cases, and those obtained by radium and the radioactive agents.

To begin with, there is still a lack of

radium has replaced the former surgical procedure. Despite the convincing statistics from the larger clinics abroad and from important medical centers here, it is astounding that every now and then surgeons and gynecologists persist in subjecting cancer of the uterus to a high operative mortality, with no better prognostic outlook in view than is obtained by the use of radium. This holds true not only in the inoperable cases, but in the early and borderline cases of carcinoma of the cervix.

As a whole, though, it is highly commendable that the large majority of cancer workers recognize this comparatively new concept. In this type of malignancy throughout almost all the larger clinics the figures of five year arrest of the disease run fairly uniform, ranging approximately from 18 to 22 per cent.

In sharp contrast to the general agreement of the end-results obtained in cancer of the uterus is the uncertainty of various observers as to the percentage of operability. In the opinion of most writers, 18 per cent represents the average operability rate of cancer of the cervix, while others submit the almost unbelievable proportion of 70 per cent and, in one instance, 81 per cent. This division of opinion calls for further criteria and more careful study as to what constitutes real operability. As a matter of fact, the ablest surgeons and gynecologists have conceded that in cancer of the cervix at all stages, radium offers

type, which by surgical procedure gives bad prognosis at best, proves to be very sensitive to radioactive substances, and therefore results in a high percentage of cures in the very group where surgery proves so helpless. These more recent studies have opened up an entirely new field, as they point to the wide differences of various tumors in their reactions to radium. The fact that tumors which exhibit highly malignant characters clinically react favorably to radium has made possible a new guide to classify most of the well-known tumors according to their radiosensitivity.

Rapid rate of growth and high metabolism of a tumor are prominent features in the favorable reaction to radium. As a rule, rapidly multiplying tissue possesses a high rate of metabolism, and generally these two go hand in hand. If, in addition to these, there exists increased vascularity in the tumor, then radiosensitivity is markedly enhanced. Upon this basis alone tumors have been classified according to their degree of sensitivity, without regard to any other factor.

If I have particularly stressed the unanimity of the viewpoints held in cancer of the cervix, it was for the purpose of emphasizing the confusion and differences of opinion apparent in cancer of the breast. My own attempts to analyze the end-results in carcinoma of the breast convince me that a great deal of further study is necessary to clear up the perplexing situation in this group of cases. It is rather disappointing to find that in one clinic 60 per cent of all breast cancers are considered operable. Such a high rate of operability is difficult to conceive, when one-half to two-thirds of the operated cases present themselves with recurrences in the scar or field of operation one or two years after the primary operation.

This confusion is brought about by the conflicting reports, which vary from 15 per cent operability in some clinics, to 63 per cent of operability in others. So, too, sta-

tistics published from various sources leave a rather unsatisfactory impression. For instance, Döderlein, Finsterer and others report five year cures of approximately 5 per cent in cancer of the breast where glands are involved, while other writers report from 19 to 39 per cent five year cures. In breast cancer without involvement of the lymph nodes, figures reported run anywhere from 46 to 100 per cent five year cures. These indefinite statistics disclose quite a chaotic situation in such an important subject. "Surgery," says Finzi, "has had so long an inning, and the procedure has become so standardized that statistics should be fairly definite." So the less said the better.

No wonder, then, that the views submitted by the various writers as to the efficacy of radiotherapy in this field are equally at variance. At this period of writing, I am at a loss to interpret intelligently just what has been accomplished by the highly perfected surgical technique in this very group of cancer, which to all intents and purposes should offer the most favorable setting for a complete surgical eradication of the disease. First of all, it should be the most easily recognizable cancer. Secondly, it lends itself to complete excision of the tumor and that of the neighboring tissue, with very little surgical risk.

It is difficult to understand then that in the face of these clinical advantages modern surgery fails to furnish clear-cut information of definite prognostic value. There is something strange when one clinic reports such unsatisfying figures as 5 per cent five year cures, in contrast to others where figures range as high as 40 per cent. To attempt to compare the end-results obtained by radiotherapy in this group of cases is obviously unfair, and tends to make this matter much more involved. To again quote Finzi: "The material with which we have had to deal is so bad, that our results cannot be good. There is no question but that we should be supplied with a better type of case."

From what has already been stated, it seems clear that it should first be definitely settled that the results in cancer of the breast from operative treatment are disappointing and unsatisfying. When we confront the problem with an open mind and critical judgment it becomes of intense interest that prognostic results obtained before and since the advent of modern surgical technique are no better now than before, and this should cause us to view the matter with much concern. It would appear then, that the effectiveness of extensive excision of the tumor should be particularly reflected in this very type of malignancy.

According to my interpretation, these incontestable facts manifestly indicate that a change of attitude is necessary. On the basis of results reported here, it is my conviction that the radium specialists must exert a strong plea to submit comparable cases to establish the effectiveness of radium in this very group. It was through the efforts of the gynecologists themselves when they submitted uterine cancer to radium and roentgen therapy that definite facts as to the true worth of these agents were ascertained. In a few quarters where primary cancer of the breast has been submitted for radiotherapy, satisfactory data are reported. In Wintz's clinic all tumors of the breast are first treated by roentgen rays and radium. After an interval of two to three months, if the tumor has not been satisfactorily controlled, a local excision of the tumor is performed. Rarely is a second treatment administered, and then only after six months to a year.

Similar procedures with gratifying results are the routine in other clinics, though larger clinical material is necessary to arrive at definite conclusions. My own personal experience in primary tumors of the breast has encouraged me to stress and advocate the use of radium in these cases. To quote Finzi again: "The use of radium needling in earlier cases has shown

marked improvements in the results, and such methods followed by extirpation, if desired, seem to offer a better chance of cure than operation with subsequent irradiation. On the other hand, prophylactic irradiation must not be withheld when operation is the method preferred. So long as surgical removal of cancer is a recognized method of treatment, irradiation must also find a place."

From the literature one gains the impression that the ablest surgeons are discouraged by the disappointing results of their best efforts and begin to lean upon the future of the radioactive agents. The strongest support is gained from the newer studies of the favorable reaction of highly malignant tumors to radium and roentgen rays. Here again, as in cancer of the uterus, the extremely cellular form of tumor which gives a bad prognosis surgically, proves to be radiosensitive to a high degree, so that a good proportion of cures is obtained from irradiation. Under these conditions it is difficult to understand why there still should be controversy upon the need of radiotherapy.

Practically all reports from reliable observers, with one or two exceptions, cite greatly increased percentages of five year cures when roentgen rays and surgery were combined in the treatment of these cases, without taking into particular account the biological and histological variations of the tumor itself. For a clearer understanding of these varying factors, it is requisite that less importance be given to the anatomical classification and more to the sensitivity of the tumor to radium.

Entirely too much misunderstanding exists concerning the cellular differentiation of the tumor. The ingenious classification of Broders, and also of MacCarty, would be of greater value if the tumor exhibited the same cellular picture throughout its entire structure, and furthermore, if we could be certain that the architecture of the cells remained the same throughout the progress of the disease.

After what has just been said, it would seem a fair inference that radium in the treatment of cancer has won an uphill fight for recognition. The usefulness of radium in cancer of the cervix has been reflected through several years of experience with a marked degree of success, and is fairly well recognized as a method of efficiency and a fair degree of accuracy in definitely selected and early cases. In the inoperable cases it has more than held its own when compared with other recognized methods of treatment. All statistics support a record of approximately 10 per cent five year cures of what were formerly considered advanced and hopeless cases.

The far-reaching discussion of the problem of cancer of the breast has engaged the attention of most of the outstanding writers, but no definite conclusions have been arrived at up to the present. In spite of the various investigations, the end-results from surgery are far from clear cut, and a most perplexing situation exists, as most essential information is missing. On the other hand, public interest makes it desirable to ascertain how great a field of usefulness radium has in the group of malignant tumors of the breast. My own personal experience coincides with that of the more recent writers, who have de-

scribed with painstaking care the end-results in a fairly large series of cases of cancer of the breast treated with some form of radium therapy, where operative procedures were omitted.

It is apparent that the ablest surgeons, not satisfied with their surgical results in breast cancer, have experienced a change of attitude towards agents other than surgery. In the main, there appears to be a division of opinion as to what is the proper thing to do in a given case of cancer of the breast. The work of the past few years, however, where primary breast cancers have been treated by irradiation alone, explains satisfactorily to those conversant with the situation, that the skillful and intelligent use of radium will compare favorably with any other form of treatment. The present work aims to cooperate in the solution of the problem of cancer of the breast. Handley says: "Each step in advance has required for its verification and establishment a period of about six years."

In closing, I cannot improve upon the words of Geoffrey Keynes, who says: "If, therefore, a method other than operation is adopted, it will not find itself in competition with any very efficient method of treatment, and results will be bad indeed if they are worse than those of operation."

#### REFERENCES

1. DALAND, E. M. Cancer of the breast. *Boston M. & S. J.*, 1927, 197, 57-60.
2. FINZI, N. S. X-rays and radium in treatment of carcinoma of the breast. *Brit. M. J.*, 1927, 2, 728-733.
3. GREENOUGH, R. B. Carcinoma of the breast at the Massachusetts General Hospital, 1918, 1919, 1920 (third series). *South M. J.*, 1925, 18, 187-192.
4. HEALY, W. P., and CUTLER, M. Radiological or operative treatment of cancer of the uterus. *Acta radiol.*, 1927, 8, 363-409.
5. HEALY, W. P., and CUTLER, M. Relation between structure and prognosis in cervical carcinoma under radiation treatment. *Am. J. Obst. & Gynec.*, 1928, 16, 15-28.
6. HEYMAN, J. Radiological or operative treatment of cancer of the uterus. *Strahlentherapie*, 1928, 29, 407-452.
7. LEE, BURTON J. Therapeutic value of irradiation in treatment of mammary cancer; survey of five-year results in 355 cases treated at the Memorial Hospital of New York. *Ann. Surg.*, 1928, 88, 26-47.
8. PFAHLER, G. E. Radiation therapy in malignant disease with special reference to saturation method. *Illinois M. J.*, 1929, 55, 177-187.
9. REGAUD, C. Radium therapy of cancer at Radium Institute of Paris. *Am. J. Roentgenol. & Rad. Therapy*, 1929, 21, 1-24.
10. RODMAN, J. S. Development of modern operation for cancer of the breast. *Atlantic M. J.*, 1928, 31, 629-631.
11. SCHMITZ, HENRY. Carcinoma of uterine cervix. *Am. J. Obst. & Gynec.*, 1927, 14, 580-590.
12. SCHMITZ, HENRY. Diagnosis and treatment of uterine cancer. *Radiol. Rev.*, 1929, 51, 191.



13. SCHREINER, B. End results of radium treatment in adeno-carcinoma of the uterus. *Radiol. Rev.*, 1929, 51, 104.
14. SCHREINER, B. Radium treatment in epithelioma of the cervix uteri. *Radiol. Rev.*, 1929, 51, 141.
15. SMITH, G. V., and BARTLETT, M. K. Malignant tumors of the female breast. *Surg., Gynec. & Obst.*, 1929, 48, 314-320.
16. WARD, G. G. Radium therapy of carcinoma of cervix uteri. *Brit. M. J.*, 1928, 2, 607-609.
17. WARD, G. G. Radium therapy of carcinoma uteri. *Am. J. Obst. & Gynec.*, 1929, 17, 1-13.
18. WEBSTER, J. H. D. Radiology and surgery in cancer of breast and in "chronic mastitis." *Lancet*, 1928, 2, 63-65.



## SARCOMA OF THE PROSTATIC AREA IN AN INFANT AGED FOUR MONTHS

### CASE REPORT

By GERARD RAAP, M.D.

*Jackson Memorial Hospital*

MIAMI, FLORIDA

**P**RECEDENCE and previous experience of others, as described in textbooks and other literature, allow us to formulate therapeutic procedures rather readily in the average case, but in rare cases experiment is not always willingly accepted by the patient and relatives, and as a consequence the autopsy findings permit an opportunity for rather careful retrospect.

In previously reported cases of this type, in at least 50 per cent of the total number, surgery constituted the only means of treatment, and surgical procedures also served to make the diagnosis possible. In this particular instance preoperative information was sufficient so that it might have been possible to employ radiation, and it is for this reason that we call attention to the history, incidence, diagnosis and symptoms, in the hope that other cases of this type may at least have the benefit of less drastic procedures.

The incidence of sarcoma of the prostate between 1839 and 1926 is reported as follows: From the time of Stafford,<sup>2</sup> who reported the first known case, to 1926, when Kretschmer<sup>6</sup> surveyed the subject, reporting 80 cases, we find that several others have made surveys which probably overlap, and we may estimate the total number to be about 100. Among others who have studied the literature are Young, Kaufmann, Ewing, Bumpus, Culver, Kline, Concetti, Deming and O'Neil. Deming,<sup>5</sup> in 1924, in a rather exhaustive article, quotes about 65 cases from a rather complete bibliography, and states that sarcoma comprises about 56.9 per cent of these cases. This classification includes sarcomata, myxosarcoma, fibrosarcoma and lymphosarcoma. Myxosarcoma con-

stitutes 25 per cent of the cases, fibroma about 7 per cent, with an occasional myoma, rhabdomyoma, fibroma, papilloma, polyp and dermoid. Angiosarcoma and chondrosarcoma have also occasionally been reported.

The average incidence shows that out of a total of 252 primary bladder tumors reported by Albarran in all ages, 211 occurred in the male and 41 in the female, and that only 6 are reported previous to the age of ten years, while the great majority occurred at the age of about four or five years. One of the earliest of which we find record is that of a sarcoma of the bladder in a girl of eleven months, reported by Concetti.<sup>3</sup>

### CASE REPORT

**Patient,** Harry G., white, aged four months, *Family History.* Father, aged twenty-eight, living and well; mother, aged twenty-five, living and well. One brother died at six weeks of age with what family physician termed uremic fever (child was swollen all over and passed no urine two days before death). Parents give no history of venereal disease. No cancer history in family. Both children were delivered normally and in each the period of gestation was normal. This baby weighed 6½ pounds at birth and had grown to 14½ pounds at three months. Never sick during this time.

*Present Illness.* One month ago, mother noticed that child strained and became very red in the face during bowel evacuation. She found that instead of the baby passing fecal matter it was forcing out urine, a few drops at a time. The mother reported this to the family physician, who suggested that the baby was teething and its bowels were upset. On Jan. 24, the baby was very fretful and the mother thinking of intestinal colic, began massaging the baby's abdomen. She discovered a swelling in the region of the bladder and called the

family physician, who administered spirits of nitre and said, "Tumor would go as it came." The tumor increased in size and hot applications were applied. The baby was brought to Miami in the late afternoon to Dr. Charles Kennon, a pediatrician, who made an effort to catheterize the bladder, but having failed, referred the case to us. Efforts to pass soft rubber and ureteral catheters into the bladder failed. A filiform was then successfully passed and the child in its fretful crying voided a small amount of urine around the filiform. A No. 12 sound was then attached to filiform and carried into bladder. Upon withdrawal, the baby was still unable to empty the bladder. Efforts to pass catheters again failed, in spite of urethral dilations from sound. A roentgenogram was then made to rule out the possibility of stone in the bladder. The films revealed an enormously distended bladder, reaching a finger's breadth above the umbilicus. No calculi were demonstrated on the film. A small hollow metal tube was then bent in the shape of a prostatic catheter, and another attempt made to enter the bladder with this devised instrument. Passing a grating obstruction in the posterior urethra, the metal catheter slid over the prostatic obstruction and into the bladder. With the improvised catheter anchored and a small rubber tube attached to the distal end so that a forceps control might be established, 700 c.c. of urine was evacuated during the next fourteen hours, by means of interval decompression. The tube was removed the following morning when evacuation was complete. In the afternoon of that day the child was brought for relief again, it having been unable to void in the interval since the tube was removed. At this time a No. 6 ureteral catheter on a stilet was introduced into the bladder and anchored there as a retention catheter. Three days later when we deemed the baby had sufficiently recovered from the acute urinary retention, a cystogram (using sodium iodide) was made, and the films revealed two distinct laterally placed lobes projecting from the prostatic area into the bladder and clearly separated by the catheter lying in the median line (Fig. 1). A rectal examination was made, using the little finger, and the tumor in the prostatic area was definitely outlined. With the finger carried high in the rectum so as to examine the retrovesical space, none of the tumor growth was palpated.

A diagnosis of tumor in the prostatic area producing vesical neck obstruction was then made.

On Jan. 30, while still considering the most feasible treatment of this case, the child's temperature suddenly went to 105°F. and showed distinct signs of acute sepsis. It was decided to do a suprapubic cystotomy immediately to provide more ample drainage.

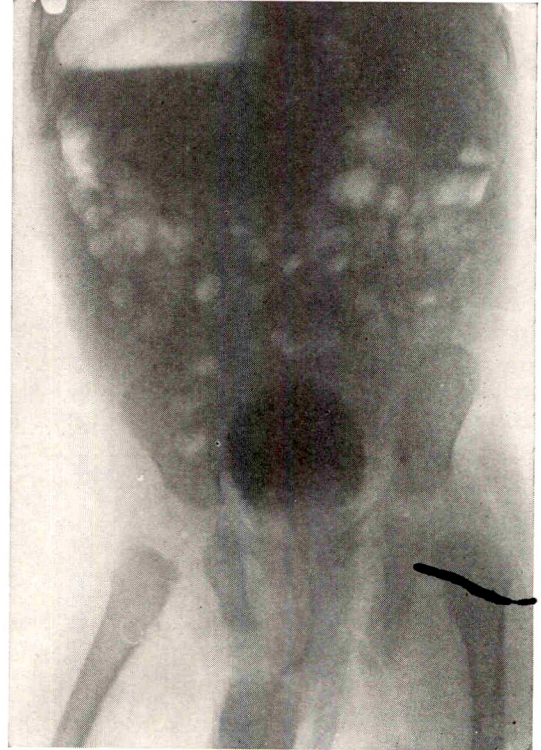


FIG. 1.

*Operation.* On opening the bladder under general ether anesthesia and exposing the vesical neck, the prostatic lobes were seen to protrude into the bladder and several small pedunculated polyps were hanging through the sphincter with their attachments apparently in the posterior urethra. Careful palpation of the bladder mucosa disclosed no abnormal tissue. It was impossible to obtain a frozen section of a portion of the tumor at the time. An examination of the posterior urethra by the little finger disclosed the fact that the tumor in the prostatic area could be easily enucleated. Believing that the only chance of saving this child's life was by removing the obstructing tissue, the operator proceeded to do a complete

prostatectomy. This having been done, a search with the examining finger was made of the retrovesical space to determine if any of the tumor growth was situated in that region. Satisfied that the growth did not extend in this direction, the prostatic area was packed with gauze, a drainage tube placed in the bladder, and the bladder, muscle and skin closed in the usual manner.

*Pathological Reports.* "Prostatic area mass submitted, consisted of two nodular masses measuring  $20 \times 15 \times 30$  mm., respectively, total weight 12 gm. Surfaces appear smoothly encapsulated except for several long string-like tags to one.

"Cut surface white, glistening, soft, homogeneous.

"Formalin-fixed, paraffin sections, stained with hematoxylin and eosin show glandular structures simulating prostatic acini widely separated by rather polymorphous-celled myxomatous tissue with stellate and spindle cells showing anastomatic processes. I should interpret this as myxosarcoma of the prostate." (Submitted by Dr. W. P. Stowe, Jackson Memorial Hospital.)

"The sections of tumor of the bladder in an infant show a definite structure of myxosarcoma. The cells are spindle, small and large, very hyperchromatic, often packed together with a little stroma in very cellular areas, and sometimes associated with much myxomatous material. In several places I find well-developed striated voluntary muscle, which I think can be traced to the tumor cells, since all stages in the growth of these muscle cells are to be observed. Some of them are nearly adult muscle cells, while others are merely small globules of acidophile cytoplasm. The acini of the gland seem to participate in the tumor process in some areas, but not in others.

"The tumor is malignant and a recurrence not improbable.

"Myxosarcomas of the prostate are well known, and I have seen others at this very early period of life." (Submitted by Dr. James Ewing, Cornell Medical School.)

*Progress of Case.* After a stormy period of several days, the child began to make splendid progress and on Feb. 12, the bladder was practically closed and the infant was voiding through the normal channel. On Feb. 18 the child began to show definite uremic symptoms,

a twitching of the arm and leg muscles, fever, and vomiting of food. As the quantity of urine was decreasing, we feared a recurrent bladder neck obstruction, but upon catheterizing the bladder found it empty. What few drops of urine we did collect showed casts and albumin. Intraperitoneal infusions, proctocyclies, etc., were of no avail, and on Feb. 22 the child died.

*Autopsy Report.* "Kidneys appear normal for age except for some swelling and dilatation of kidney pelves. Ureters are greatly dilated. At the ureteral mouths on both sides, beneath the the mucosa and surrounding both mouths are masses of white tissue about 1.5 cm. across.

"Microscopic sections of these nodes show, between the muscle fibres of the bladder, infiltrating sheets and masses similar to the stromal tissue of the original prostatic neoplasm.

"Examination of spleen, lungs, and liver shows normal organs with no metastasis.

"Diagnosis: Extension of prostatic myxosarcoma. Hydroureter and hydronephrosis bilateral."

*Comments.* In addition to the fact that this probably represents one of the youngest cases of sarcoma of the prostatic area, it is interesting from the fact that the information obtained before operation will serve to restrain too hasty surgery in other instances of this type. In our discussion we felt that the alternative in diagnosis was that of polypoid growths. The advisability of irradiation was discussed, but we were of the impression that delay in relieving the retention was not justified, and in addition we were not at all certain of our differentiation with relation to the benign or malignant character of these masses. In the cases which Deming reports irradiation was used in one instance, together with diathermy, but even then a recurrence within six weeks was evidence that the treatment had been inadequate, therefore, resection was again resorted to. Total cystectomy has been advised by Albarran<sup>7</sup>, and again by Darling in 1925. One case which he reports lived longer after operation than any other patient with myxoma, but whether the tumor was at all retarded by excision and



irradiation is still problematic. In discussing this particular case with Dr. Bloodgood, his advice was that irradiation should have been used to save life, even at all costs to other sequelae. This had been explained to the patient's parents, but was not acceptable. We felt particularly gratified that the diagnosis of tumor of the prostatic area in extreme infancy has been made by cystographic methods, and we believe that it is a definitely indicated diagnostic procedure in all cases of this type. It might have been of interest to make ureterograms early in

the course of the disease, to give us information as to the degree to which these ureters may be dilated in infants.

There is a slight disagreement of opinion with reference to the etiology or histogenesis of this tissue. We note that this has also occurred in the previously reported cases.\*

\* We wish to express our thanks to Drs. Ewing and Stowe for their interest in the pathologic specimens, and to Dr. Bloodgood for his advice, as well as to Drs. Holmes and Coplan for their cooperation in reporting this case. It will undoubtedly appear in the urologic journals under their authorship.

#### REFERENCES

1. BUMPUS, HERMAN C. JR. Radium and roentgen ray in the treatment of sarcoma of the prostate. *J. Urol.*, 1925, 14, 519-533.
2. CABOT. Modern Urology. Volume 1, p. 802.
3. CONCETTI, L. *Verhandl. d. Gesellsch. f. Kinderh., Wiesb.*, 1899, 16, 240-245.
4. CULVER, HARRY. Sarcoma of the prostate. *J. Urol.*, 1925, 14, 47-55.
5. DEMING, C. L. Primary bladder tumors in the first decade of life. *Surg., Gynec. & Obst.*, 1924, 39, 432-442.
6. KRETSCHMER, H. L. Sarcoma of the prostate. *J. Urol.*, 1926, 16, 301-305.
7. O'NEIL, R. F. Bladder tumors in the young. *Boston M. & S. J.*, 1915, 173, 873-877.
8. PARMENTER, F. J. Sarcoma of the prostate. *Surg., Gynec. & Obst.*, 1917, 24, 336-339.
9. YOUNG, H. H. Practice of Urology, Volume 1.





DR. W. D. COOLIDGE  
*Caldwell Lecturer, 1930*

# THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

*Editor:* LAWRENCE REYNOLDS, M.D.

*Editorial Board:* A. C. CHRISTIE, M.D. H. K. PANCOAST, M.D. WILLIAM DUANE, PH.D.

*Advisory Board for Pathology:* JAMES EWING, M.D. EUGENE OPIE, M.D. A. S. WARTHIN, M.D.

*Collaborating Editors:* The Officers and Committee Members of the Societies of which this JOURNAL is the official organ, whose names appear on this page, are considered collaborating editors of this JOURNAL.

*Foreign Collaborators:* A. BÉCLÈRE, M.D., PARIS. GÖSTA FORSSELL, M.D., STOCKHOLM, G. F. HAENISCH, M.D., HAMBURG. R. LEDOUX-LEBARD, M.D., PARIS.

*Publisher:* CHARLES C. THOMAS, SPRINGFIELD, ILL.

*Issued Monthly. Subscription \$10.00 per year, \$11.00 in Canada and \$12.00 in foreign countries. Advertising rates submitted on application. Editorial office, 110 Professional Building, Detroit, Mich. Office of publication, 220 E. Monroe St., Springfield, Ill. Information of interest to all readers will be found on page iv.*

## Officers and Standing Committees

### THE AMERICAN ROENTGEN RAY SOCIETY

*President:* H. M. IMBODEN, New York City;  
*President-Elect:* A. B. MOORE, Rochester, Minn.;  
*1st Vice-President:* H. E. RUGGLES, San Francisco, Calif.; *2d Vice-President:* B. H. NICHOLS, Cleveland, Ohio; *Secretary:* JOHN T. MURPHY, 421 Michigan St., Toledo, Ohio; *Treasurer:* WILLIAM A. EVANS, 10 Peterboro St., Detroit, Mich.; *Librarian and Historian:* H. W. DACTLER, Toledo, Ohio.

*Executive Council:* W. F. MANGES, Chairman, 235 S. 14th St., Philadelphia, Pa., L. R. SANTE, St. Louis, Mo., F. M. HODGES, Richmond, Va., H. M. IMBODEN, New York City, A. B. MOORE, Rochester, Minn., LAWRENCE REYNOLDS, Detroit, Mich., JOHN T. MURPHY, Toledo, Ohio, WILLIAM A. EVANS, Detroit, Mich.

*Committee on Laws and Public Policy:* B. R. KIRK-LIN, Chairman, Rochester, Minn., FRED M. HODGES, Richmond, Va., WILLIAM E. CHAMBERLAIN, San Francisco, Calif.

*Committee on Safety and Standards:* P. M. HICKEY, Chairman, University Hospital, Ann Arbor, Mich., H. K. PANCOAST, Philadelphia, Pa., W. D. COOLIDGE, Schenectady, N. Y., A. U. DESJARDINS, Rochester, Minn., H. J. ULLMANN, Santa Barbara, Calif., B. H. NICHOLS, Cleveland, Ohio, G. E. RICHARDS, Toronto, Canada, R. R. NEWELL, San Francisco, Calif.

*Publication Committee:* WILLIAM A. EVANS, Chairman, Detroit, Mich., W. F. MANGES, Philadelphia, Pa., L. R. SANTE, St. Louis, Mo.

*Leonard Prize Committee:* P. M. Hickey, Chairman, Ann Arbor, Mich., W. B. BOWMAN, Los Angeles, Calif., A. C. CHRISTIE, Washington, D. C., W. A. EVANS, Detroit, Mich., G. W. GRIER, Pittsburgh, Pa., B. H. NICHOLS, Cleveland, Ohio, G. E. PFAHLER, Philadelphia, Pa.

*Tube Committee:* DAVID R. BOWEN, Chairman, Philadelphia, Pa., I. H. LOCKWOOD, Kansas City, Mo., E. C. ERNST, St. Louis, Mo., G. W. GRIER, Pittsburgh, Pa., E. A. POHLE, Madison, Wis.

*Member, National Research Council:* W. F. MANGES, Philadelphia, Pa.

*Delegate to Third International Congress, Paris, July 27-31, 1931:* P. M. HICKEY, Ann Arbor, Mich.;  
*Alternate,* LEOPOLD JACHES, New York City.

*Editor:* LAWRENCE REYNOLDS, 110 Professional Building, Detroit, Mich.

*Editorial Board:* A. C. CHRISTIE, H. K. PANCOAST, WM. DUANE.

*Advisory Board for Pathology:* JAMES EWING, EUGENE OPIE, ALDRED S. WARTHIN.

*Publisher:* CHARLES C. THOMAS, 220 East Monroe St., Springfield, Ill.

*Thirty-first Annual Meeting:* West Baden Springs Hotel, West Baden, Indiana, Sept. 23-26, 1930.

### THE AMERICAN RADIUM SOCIETY

*President:* H. H. BOWING, Mayo Clinic, Rochester, Minn.; *President-Elect:* H. J. ULLMANN, Santa Barbara, Calif.; *First Vice-President:* SANFORD WITHERS, Denver, Colo.; *Second Vice-President:* EDITH H. QUIMBY, New York City; *Secretary:* G. W. GRIER, Jenkins Arcade, Pittsburgh, Pa.; *Treasurer:* ZOE A. JOHNSTON, Jenkins Arcade, Pittsburgh, Pa.

*Executive Committee:* ALBERT SOILAND, Chairman, 1407 S. Hope St., Los Angeles, Calif., CURTIS F. BURNAM, Baltimore, Md., EDWIN C. ERNST, St. Louis, Mo.

*Program Committee:* H. J. ULLMANN, Chairman, 1520 Chapala St., Santa Barbara, Calif., L. R. SANTE, St. Louis, Mo., WILLIAM NEILL, Baltimore, Md.

*Publication Committee:* H. K. PANCOAST, Chairman, University Hospital, Philadelphia Pa., HENRY SCHMITZ, Chicago, Ill., JAMES T. CASE, Chicago, Ill.

*Research and Standardization Committee:* G. FAILLA, Chairman, Memorial Hospital, New York City, H. J. ULLMANN, Santa Barbara, Calif., R. B. GREENOUGH, Boston, Mass.

*Education and Publicity Committee:* SANFORD WITHERS, Chairman, Majestic Bldg., Denver, Colo., G. E. PFAHLER, Philadelphia, Pa., D. T. QUIGLEY, Omaha, Nebr.

*Sixteenth Annual Meeting:* 1931, to be announced.

*Committee on Arrangements:* R. E. LOUCKS, Chairman, 337 W. Grand Blvd., Detroit, Mich., R. H. STEVENS, Detroit, Mich., L. B. ASHLEY, Detroit, Mich.

# EDITORIAL

## THE FUTURE OF RADIOLOGY AS A SPECIALTY

WHENEVER radiologists gather together one is apt to hear expressions of apprehension as to the future of radiology as a specialty of medicine. The attitude of many hospitals toward radiology and the radiologist, the more or less extensive use of roentgen rays and radium by other specialists and by general practitioners, and the commercial laboratory problem are all cited as evidence of the precarious position which radiology occupies.

Perhaps a consideration of the genesis and evolution of medical specialties would to a large degree mitigate the radiologist's misgivings, and also point the way to a better shaping of his destinies.

It is not necessary for our purpose to go into the genesis of specialization further than to state that it is a natural response to a general demand that all available knowledge be properly used and applied. Everyone recognizes that something is gained and lost in the process, but if not carried to extremes it more nearly meets the demands of the situation than anything we have to offer.

Once launched, a specialty goes through certain changes before it becomes stabilized and permanently adjusted to medical practice as a whole.

In the earlier stages of its evolution its fate rests entirely with the medical profession. The pioneer in a new specialty is usually entirely dependent on the patronage of practitioners in other fields and under such circumstances is apt to be regarded more or less patronizingly by them. He is expected to confine his activities within narrow bounds, even though his patrons, who may themselves be specialists, practice their art along much

broader lines. The duration of this period of professional domination will depend upon varying circumstances, but sooner or later if the new specialty is to survive it will enter upon a period of transition in which its fate passes beyond the domination of the profession as a whole and finally to become vested in the public. This readjustment takes place so gradually that the participants in it do not realize that it is occurring. Patient dissatisfaction with the specialist on the one hand, and the general practitioner on the other, doubtless continue to repress their feelings, but with this added impetus the patient expects it, and in the ordinary course of events would likely go to him anyway. It ultimately transpires that the specialist finds himself referring about as many patients to other physicians as they refer to him. When such a reciprocal relationship has been established the specialty may be said to have become stabilized, and thereafter its fortune will depend largely on the measure of public respect and esteem it may be able to command.

All of the evolutionary processes sketched above can be traced in the development of radiology as a specialty. That it has not as yet reached a state of complete stabilization is quite apparent, but that it will do so eventually seems assured, and the lines along which it will be accomplished are plainly evident. In the past the radiologist has quite naturally been primarily solicitous of the patronage of physicians in other fields, as was, and still is, natural and proper. It is certain, however, that he has not taken advantage of his opportunities to encourage public favor and thereby establish a clientele of his own upon which his ultimate status will de-



pend. He has narrowed his field of endeavor to unreasonable limits, and has so detached himself from what we ordinarily understand as the practice of medicine that many of them know very little about the relationship of doctor and patient that obtains in every other department of clinical medicine. It is questionable, indeed, if the radiologist who spends the major portion of his time running hither and yon "reading films" has much more justification for styling himself a practitioner of medicine than has a proof reader to style himself an author. The principles of "mass production" of which we hear so much in the industrial world cannot be successfully

applied to radiology or any other branch of medicine.

It is fortunate for radiology, that throughout its vicissitudes, many of its leaders have maintained their status as practitioners of medicine in every sense of the word, and that they are not only highly regarded as consultants by their professional colleagues, but by an ever increasing clientele outside the profession. With a maintenance of such leadership a bright future for radiology is assured, and to young men with proper background it offers splendid opportunities.

T. A. GROOVER



# SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

*Items for this section solicited promptly after the events to which they refer.*

## MEETINGS OF ROENTGEN SOCIETIES\*

### UNITED STATES OF AMERICA

#### AMERICAN ROENTGEN RAY SOCIETY

Secretary, Dr. John T. Murphy, 421 Michigan St., Toledo, Ohio.

Thirty-first annual meeting: West Baden Springs Hotel, West Baden, Indiana, Sept. 23-26, 1930.

#### AMERICAN COLLEGE OF RADIOLOGY

Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles, Calif.

Annual Meeting, 1931, to be announced.

#### SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION

Secretary, Dr. G. W. Grier, Jenkins Arcade, Pittsburgh, Pa.

Annual meeting, 1931, to be announced.

#### RADIOLOGICAL SOCIETY OF NORTH AMERICA

Secretary, Dr. I. S. Trostler, 812 Marshall Field Annex, Chicago, Ill.

Sixteenth annual session: Los Angeles, Calif., Dec. 1-5, 1930.

#### RADIOLOGICAL SECTION, LOS ANGELES COUNTY MEDICAL SOCIETY

Secretary, Dr. Orville N. Meland, 1407 S. Hope St., Los Angeles.

Meets on the third Wednesday of each month at the California Hospital.

#### RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION

Secretary, Dr. W. S. Lawrence, Medical Arts Bldg., Memphis, Tenn.

#### BUFFALO RADIOLOGICAL SOCIETY

Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St.

Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.

#### CHICAGO ROENTGEN SOCIETY

Secretary, Dr. Robert A. Arens, Michael Reese Hospital.

Meets monthly on second Thursday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

#### CLEVELAND RADIOLOGICAL SOCIETY

Secretary, Dr. Harry L. Farmer, 2930 Prospect Ave.

Meetings are held at 6 o'clock at the University Club on the fourth Monday evening of each month from September to April, inclusive.

#### DETROIT ROENTGEN RAY AND RADIUM SOCIETY

Secretary, Dr. O. J. Shore, Fisher Building, Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

#### CENTRAL ILLINOIS RADIOLOGICAL SOCIETY

Secretary, Dr. H. C. Kariher, Decatur, Illinois. Regular meetings held quarterly.

#### INDIANA ROENTGEN SOCIETY

Secretary, Dr. J. N. Collins, Indianapolis, Ind. Annual meeting each February 22 in Indianapolis.

#### MILWAUKEE ROENTGEN RAY SOCIETY

Secretary, Dr. J. E. Habbe, 221 Wisconsin Ave., Milwaukee.

Meets first Friday in October, December, February and April.

Place of meeting designated by the president.

#### MINNESOTA RADIOLOGICAL SOCIETY

Secretary, Dr. L. G. Rigler, University Hospital, Minneapolis, Minn.

#### NEW ENGLAND ROENTGEN RAY SOCIETY

Secretary, Dr. Thomas R. Healy, 370 Marlboro St., Boston, Mass.

Meets monthly on third Friday, Boston Medical Library.

#### NEW YORK ROENTGEN SOCIETY

Secretary, Dr. Robert E. Pound, Fifth Avenue Hospital.

Meets monthly on third Monday, New York Academy of Medicine.

#### CENTRAL NEW YORK ROENTGEN RAY SOCIETY

Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

#### PACIFIC COAST ROENTGEN RAY SOCIETY

Secretary, Dr. Harold B. Thompson, Seattle, Wash. Two meetings a year.

#### PENNSYLVANIA RADIOLOGICAL SOCIETY

Secretary, Dr. W. E. Reiley, Clearfield, Penna. Two meetings a year, April and October.

\* Secretaries of societies not here listed are requested to send the necessary information to the Editor.

**PHILADELPHIA ROENTGEN RAY SOCIETY**  
Secretary Dr. John T. Farrell, Jr., 235 S. 15th St., Philadelphia.

Meets monthly on first Thursday evening, Pennsylvania Hospital.

**ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.**

Secretary, Dr. James M. Flynn, 282 Alexander St.

Meets monthly on the first Friday evening at 7:45 at the Rochester Medical Association Building.

**ST. LOUIS ROENTGEN CLUB**

Secretary-Treasurer, Dr. L. R. Sante, Missouri Building

Meets first week of each month. Time and place of meetings designated by president.

**TEXAS RADIOLOGICAL SOCIETY**

Secretary-Treasurer, Dr. C. P. Harris, Houston, Texas.

Meets annually one day preceding the meeting of the Texas State Medical Association.

**UNIVERSITY OF MICHIGAN ROENTGEN RAY SOCIETY**

Secretary, Dr. D. M. Clark, University Hospital, Ann Arbor, Mich.

Meets every Wednesday evening from September to July, at 7:30 o'clock in the amphitheatre of the University Hospital.

**VIRGINIA ROENTGEN RAY CLUB**

Secretary, Dr. Wright Clarkson, 205 S. Sycamore St., Petersburg, Va.

Next meeting, Norfolk, Va., 1 P.M., Wednesday, Oct. 22, 1930.

#### CUBA

**SOCIEDAD CUBANA DE RADIOLOGIA Y FISIOTERAPIA**

Secretary, Dr. Francisco Padron, Enrique Villuendas 64, Havana, Cuba. Meets monthly in Havana.

#### BRITISH EMPIRE

**BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY**

Meets on the third Thursday of each month, from November to June inclusive, at 8:15 P.M., at 32 Welbeck St., London, W. 1., or as advertised.

**ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)**

Meets on the third Friday of each month during the winter at 8:30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

**SECTION OF RADIOLOGY AND MEDICAL ELECTRICITY, AUSTRALASIAN MEDICAL CONGRESS**

Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

**RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION**

Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.

Meets monthly at Melbourne during the winter.

**SECTION ON RADIOLOGY, CANADIAN MEDICAL ASSOCIATION**

Secretary, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.

**RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION**

Secretary, Dr. P. C. Fenwick, The Hospital, Christ-church.

Meets annually.

#### CONTINENTAL EUROPE

**BELGIAN SOCIETY OF ROENTGENOLOGY**

Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).

Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

**SOCIÉTÉ DE RADIOLOGIE MÉDICALE DE FRANCE**

Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

**SOCIÉTÉ SUISSE DE RADIOLOGIE (SCHWEIZERISCHE RÖNTGEN-GESELLSCHAFT)**

Secretary for French language, Dr. A. Grosjean, La Chaux de Fonds.

Secretary for German language, Dr. Scheurer, Molzgasse, Biel.

Meets annually in different cities.

**SOCIÉTÉ FRANCAISE D'ELECTROTHÉRAPIE ET DE RADIOLOGIE MÉDICALE**

Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

**ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHOSLOVAKIA**

Secretary, Dr. Walter Altschul, German University, Prague, 11/52.

**DEUTSCHE RÖNTGEN-GESELLSCHAFT (GESELLSCHAFT FÜR RÖNTGENKUNDE UND STRAHLENFORSCHUNG)**

Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.

Permanent secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.

**SUD- UND WESTDEUTSCHE RÖNTGENGESELLSCHAFT**

Meets annually in different cities.

**NORD- UND OSTDEUTSCHE RÖNTGENGESELLSCHAFT**

Meets annually in different cities.

**DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY**

Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

**SOCIETA ITALIANA RADIOLOGIA MEDICA**

Secretary, Professor M. Ponzio, University of Turin, Turin.

**SOCIETATEA ROMANA DE RADIOLOGIE SI ELECTROLOGIE**

Secretary, Dr. Nicolae Busila, 44 Elizabeta Blvd., Bucarest.

Meets second Monday in every month with the exception of July and August.

**ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR** in the State Institute of Roentgenology and Radiology, 6 Roentgen St.

Secretaries, Drs. S. A. Reinberg and S. G. Simonson.

Meets annually.

**LENINGRAD ROENTGEN RAY SOCIETY**

Secretaries, Drs. S. G. Simonson and G. A. Gusterin.

Meets monthly on the first Monday at 8 o'clock in the State Institute of Roentgenology and Radiology, Leningrad.

**MOSCOW ROENTGEN RAY SOCIETY**

Secretaries, Drs. L. L. Holst, A. W. Ssamysgin and S. T. Konobejevsky.

Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

**POLISH SOCIETY OF RADIOLOGY**

Secretary, Dr. A. Elektorowicz, 19 Hoza St., Warsaw. Meets annually.

**WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY**

Secretary, Dr. B. Krynski, 11 Zielna St.

Meets once a month except in the summertime.

**SCANDINAVIAN ROENTGEN SOCIETIES**

The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with the exception of the Denmark Society, meets every second month except in the summertime:

**SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN**

Meets in Stockholm.

**SOCIETY OF MEDICAL RADIOLOGY IN NORWAY**

Meets in Oslo.

**SOCIETY OF MEDICAL RADIOLOGY IN DENMARK**

Secretary, Dr. Q. Wissing, Copenhagen.

Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

**SOCIETY OF MEDICAL RADIOLOGY IN FINLAND**

Meets in Helsingfors.

**VIENNA SOCIETY OF ROENTGENOLOGY**

Secretary, Professor Holzknacht, Vienna, IX, General Hospital.

Meets on the first Tuesday of each month from October to July.

**THE ANNUAL MEETING**

The Thirty-first Annual Meeting of the American Roentgen Ray Society will be held at West Baden Springs, West Baden, Indiana, from September 23 to 26, inclusive, 1930.

West Baden Springs is situated in the beautiful Lost River Valley of southern Indiana, about thirty-five miles from the center of population of the United States, thereby making it accessible from all portions of the country. It is reached by the Monon and Southern Railroads and by five state and national hard-surfaced highways from Chicago, St. Louis, Indianapolis, Cincinnati, Evansville and Louisville, and there is through Pullman service from New York, Chicago, St. Louis, Cincinnati and Memphis. Any railroad ticket agent will supply detailed information as to the best railroad routes to take in reaching West Baden.

The convention is to be held in the West Baden Springs Hotel which offers every facility for an ideal meeting place, as the physical equipment is such that all of the assembly halls and exhibit rooms are under the same roof and there is ample room in the same hotel for the accommodation of the entire membership of the Society and their guests. In addition to the physical equipment of the hotel, which is splendid, there are opportunities offered for all sorts of entertainment including outdoor sports, such as horseback riding and golf. It was the purpose of the president-elect and his committee to arrange the program so that the members would have ample opportunity to enjoy the variety of entertainment offered by the hotel.

While no specific entertainment is planned for the ladies it was thought that the usual recreations offered by a summer resort hotel would be sufficient to assure the wives and children of members a pleasant vacation and the Society extends them a cordial invitation to attend the meeting.



The rates at the hotel are those usual at a resort hotel and it is urged that those contemplating attending the meeting make their reservations as soon as possible.

The railroads have granted reduced rates to the Society but the members must obtain a certificate at the time they purchase their tickets and it is urged that each member do this so that sufficient number of certificates will be obtained to permit of the rebate.

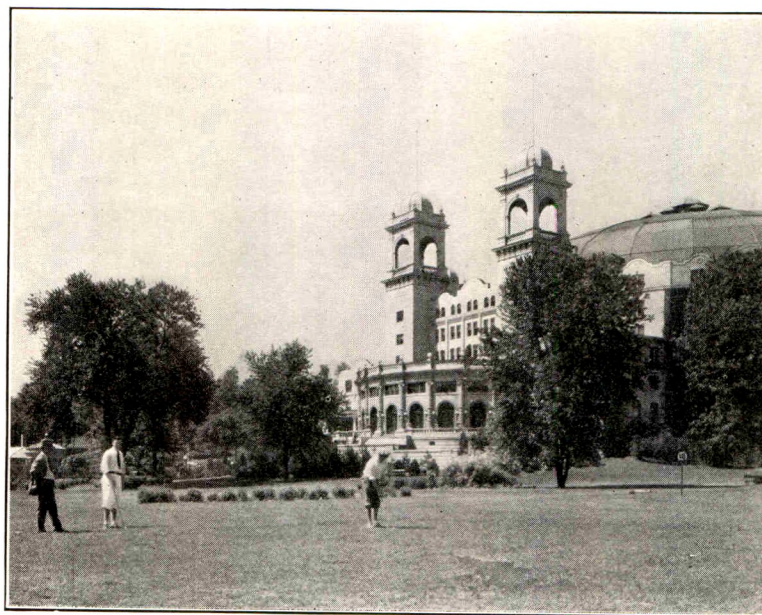
For those who anticipate driving to the convention the routes from the various

DETROIT—U. S. Rd. 112 to Coldwater then U. S. Rd. 27 via Angola to Fort Wayne thence U. S. Rd. 24 to Huntington—Rd. 9 to Anderson—Rd. 67 to Indianapolis—Rd. 37 to Paoli—Rd. 56 to West Baden.

Or,

DETROIT—U. S. Rd. 25 to Toledo—U. S. Rd. 24 to Defiance—Rd. 18 to Hicksville thence paved county road to Fort Wayne—then follow above route from Fort Wayne via Indianapolis to West Baden. (Either route all paved.)

CLEVELAND—U. S. Rd. 42 to junction with U. S. Rd. 40 thence on Rd. 40 to junction



A View of West Baden Springs Hotel

cities are given. While it is believed that these routes are accurate, it is suggested that those who anticipate driving check them through their local automobile clubs.

#### ROUTES TO WEST BADEN

*From*

CHICAGO—U. S. Rd. 41 to junction with U. S. Rd. 52 thence on Rd. 52 to Indianapolis—then Rd. 37 to Paoli—Rd. 56 to West Baden.

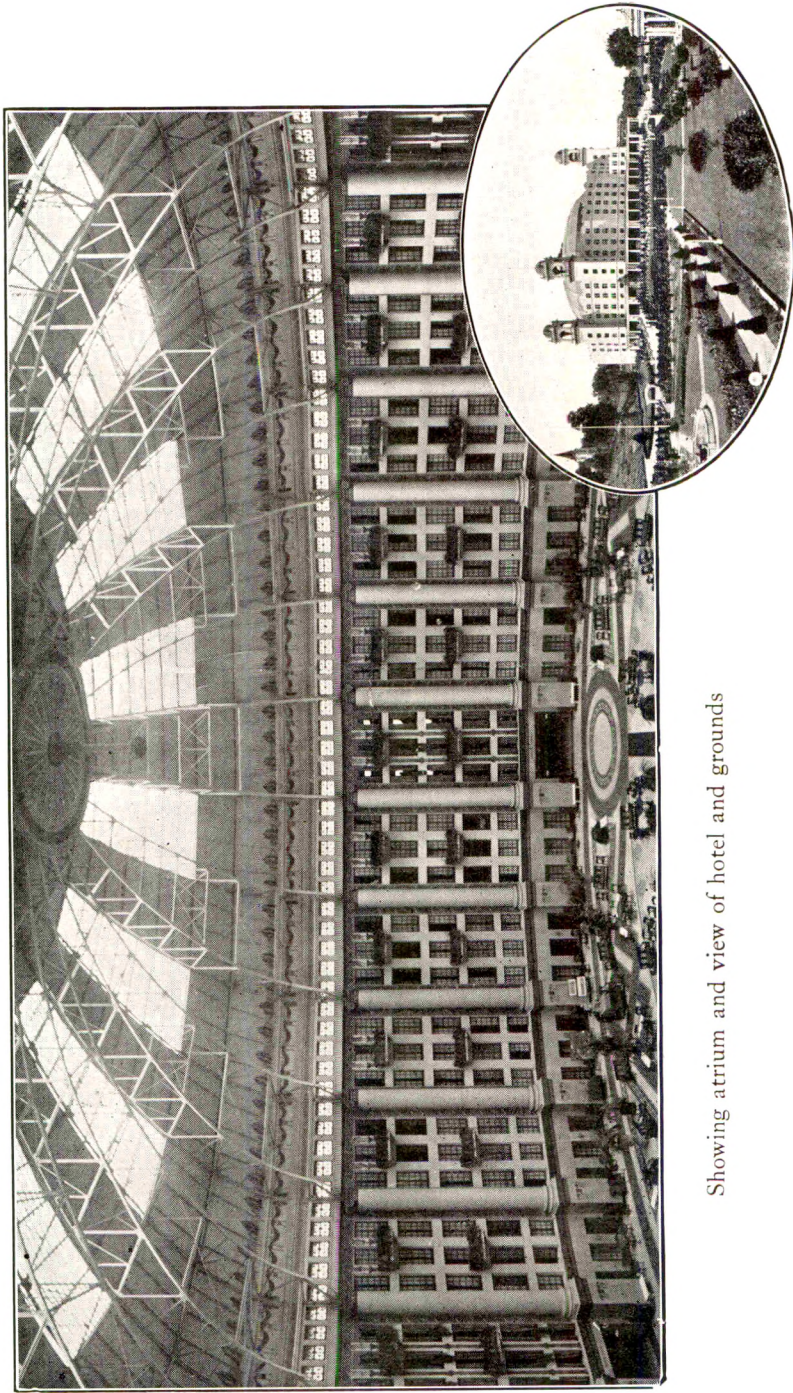
ST. LOUIS—U. S. Rd. 50 via Vincennes, Washington to junction with U. S. Rd. 150 and Rd. 56, on Rd. 56 to West Baden. (Eight mile detour at present time, over good gravel road.)

with Rd. 201 via Dayton—Rd. 11 to Eaton—Richmond thence U. S. Rd. 40 to Indianapolis—Rd. 37 to Paoli—Rd. 56 to West Baden. (Detour on U. S. Rd. 40 in Ohio east of Ind.-Ohio line.)

CINCINNATI—U. S. Rd. 50 to Versailles—Rd. 29 to Madison—Rd. 56 to Scottsburg—U. S. Rd. 31 to New Albany—Rd. 62 to Junction with Rd. 35—then Rd. 35 to Palmyra—U. S. Rd. 150 to Paoli, Rd. 56 to West Baden. (Rd. 62 and Rd. 35 is used as the detour for Rd. 150 from New Albany to Palmyra.)

ATLANTA—U. S. Rd. 41 via Chattanooga to Nashville—thence Rd. 6 and U. S. Rd. 31 to Louisville (all paved except few miles in





Showing atrium and view of hotel and grounds

Kentucky) thence to New Albany—Rd. 62 to junction with Rd. 35—then Rd. 35 to Palmyra—Rd. 150 to Paoli and Rd. 56 to West Baden. (Nashville via Louisville—296 miles.)

NASHVILLE—U. S. Rd. 41 to Evansville—Rd. 62 to junction Rd. 45 then Rd. 45 to junction Rd. 56 then Rd. 56 to West Baden. (Nashville via Evansville—269 miles.)

## PROGRAM

### AMERICAN ROENTGEN RAY SOCIETY

TUESDAY, SEPTEMBER 23, 1930  
9:30 A.M.

Diagnosis of Extra-bowel Pathology. P. F. Butler, M.D., Boston, Massachusetts. Discussion to be opened by John Sproull, M.D., Haverhill, Massachusetts.

Epiphyseal Tuberculosis of the Spine. Howard P. Doub, M.D., and Carl E. Badgley, M.D. (by invitation), Detroit, Michigan. Discussion to be opened by E. S. Blaine, M.D., Chicago, Illinois.

Further Observation on the Treatment of Superficial Malignancy. G. W. Grier, M.D., Pittsburgh, Pennsylvania. Discussion to be opened by G. E. Pfahler, M.D., Philadelphia, Pennsylvania.

The Roentgen Ray Toleration Dose for the Myocardium of Rats. Aldred S. Warthin, M.D., Ann Arbor, Michigan (by invitation), and Ernst A. Pohle, M.D., Madison, Wisconsin. Discussion to be opened by H. P. Doub, M.D., Detroit, Michigan.

The Roentgenologist in Industrial Surgery. E. C. Samuel, M.D., and E. R. Bowie, M.D., New Orleans, Louisiana. Discussion to be opened by Stanley Clark, M.D., South Bend, Indiana.

TUESDAY, SEPTEMBER 23, 1930  
2:00 P.M.

Technique and Differential Roentgen Diagnosis of Carcinoma of the Pelvic Colon. James T. Case, M.D., Chicago, Illinois. Discussion to be opened by

George W. Holmes, M.D., Boston, Massachusetts.

A. A Method of Infant Posture Fixation.

B. A Posture Instrument for Lateral Exposure of Cervical Spine.

C. A Radium Applicator for the Tonsil.

D. High Voltage X-Ray Therapy of the Pelvis through the Perineal Port. David R. Bowen, M.D., Philadelphia, Pennsylvania.

Opaque Oil in Maxillary Sinus Disease. R. C. Beeler, M.D., L. A. Smith, M.D., and J. W. Collins, M.D., (by invitation) Indianapolis, Indiana. Discussion to be opened by Frederick M. Law, M.D., New York.

A Clinical Evaluation of Variable Qualities of Roentgen and Radium Rays for the Treatment of Cancer. Bernard P. Widmann, M.D., Philadelphia, Pennsylvania. Discussion to be opened by Howard E. Ruggles, M.D., San Francisco, California.

The Nasal Accessory Sinuses: Roentgenographic and Clinical Observations. Bundy Allen, M.D., Tampa, Florida. Discussion to be opened by J. Brown Farrior, M.D., Tampa, Florida.

Automatic Polarizer for Synchronous Rectifier. Robert B. Taft, M.D., Charleston, South Carolina. Discussion to be opened by David R. Bowen, M.D., Philadelphia, Pennsylvania.

TUESDAY EVENING, SEPTEMBER 23, 1930  
William Conrad Roentgen and the Discovery of the Roentgen Rays. Otto Glasser, M.D., Cleveland, Ohio.  
Early Roentgen History. E. H. Skinner, M.D., Kansas City, Missouri.

WEDNESDAY, SEPTEMBER 24, 1930  
9:00 A.M.

Pneumoconiosis (Silicosis).

(a) The Pathological Characteristics. H. K. Pancoast, M.D., Philadelphia, Pennsylvania.

(b) The Roentgenological Aspects. E. P. Pendergrass, M.D., Philadelphia,

Pennsylvania. Discussion to be opened by M. J. Hubeny, M.D., Chicago, Illinois.

X-Ray Diagnosis and the Roentgen Therapeutic Results in Lymphosarcoma of the Mediastinum and Lungs. Webster W. Belden, M.D., and John Remer, M.D., New York, New York. Discussion to be opened by Rollin H. Stevens, M.D., Detroit, Michigan.

A Discussion of the Occurrence of Benign Ulcer on the Greater Curvature. John Sproull, M.D., Haverhill, Massachusetts. Discussion to be opened by Fred M. Hodges, M.D., Richmond, Virginia.

Subject to be announced later. William Gregory Cole, M.D., New York, New York, (by invitation).

Is Irritation a Cause of Cancer? Arthur W. Erskine, M.D., Cedar Rapids, Iowa. Discussion to be opened by U. V. Portmann, M.D., Cleveland, Ohio.

#### WEDNESDAY AFTERNOON

SEPTEMBER 24, 1930

2:00 P.M.

Gallstone Obstruction of the Duodenum. A. W. Crane, M.D., Kalamazoo, Michigan.

The Roentgen Management of Chronic Leukemia. Ross Golden, M.D., K. R. McAlpin, M.D., (by invitation), and Katherine S. Edsall, B.S., (by invitation), New York, New York. Discussion to be opened by Charles L. Martin, M.D., Dallas, Texas.

Lesions of the Diaphragm. E. L. Jenkinson, M.D., Chicago, Illinois. Discussion to be opened by B. R. Kirklin, M.D., Rochester, Minn.

Pulmonary Tuberculosis: Errors in Differential Diagnosis. (Lantern Demonstration). Leon T. LeWald, M.D., New York, New York. Discussion to be opened by George W. Holmes, M.D., Boston, Massachusetts.

Roentgen Observations on the Movement of Pleural Effusions: Leo G. Rigler, M.D.,

Minneapolis, Minnesota. Discussion to be opened by W. F. Manges, M.D., Philadelphia, Pennsylvania.

Blood Changes in the Lymphomata and the Leukemias and their Bearing on Roentgen Ray Therapy. Raphael Isaacs, M.D., Ann Arbor, Michigan. Discussion to be opened by W. Edward Chamberlain, M.D., San Francisco, California.

#### WEDNESDAY EVENING, SEPTEMBER 24, 1930

The Relationship between the Roentgenologist and the Surgeon in the Treatment of Diseases of the Stomach and Duodenum. D. C. Balfour, M.D., Rochester, Minnesota (by invitation).

Caldwell Lecture. The Development of Modern X-Ray Generating Apparatus. W. D. Coolidge, Ph.D., Schenectady, New York.

#### THURSDAY, SEPTEMBER 25, 1930

9:00 A.M.

The Value of the Roentgenological Examination in Pulmonary Tuberculosis. Lawrason Brown, M.D., Saranac Lake, New York, and H. L. Sampson, Trudeau, New York (by invitation).

The Treatment of Mixed Tumors of the Parotid Gland. E. A. Merrit, M.D., Washington, D. C., Discussion to be opened by Eugene Leddy, M.D., Rochester, Minn.

A Study of Forty-Two Cases of Melanosarcoma. William A. Evans, M.D., Detroit, Michigan. Discussion to be opened by George E. Pfahler, M.D., Philadelphia, Pennsylvania.

Tuberculous Atelectatic Cirrhosis of the Lung: Its Roentgenologic Significance. Karl Kornblum, M.D., and Richard T. Ellison, M.D., Philadelphia, Pennsylvania (by invitation). Discussion to be opened by L. R. Sante, M.D., St. Louis, Mo.

Malpractice Hazards of X-Ray and Insurance Against Them. H. F. Wanvig, New York, New York.



THURSDAY AFTERNOON

SEPTEMBER 25, 1930

Congenital Idiopathic Hypertrophy of the Heart with the Roentgen Findings in Two Cases. George W. Holmes, M.D., Boston, Massachusetts. Discussion to be opened by A. W. Crane, M.D., Kalamazoo, Michigan.

Further Studies in the Application of Intravenous Cholecystography and Liver Function Determination as Employed in Office Practice. Charles A. Waters, M.D., and Whitmer B. Firor, M.D. (by invitation), Baltimore, Maryland.

Necessity for Accurate Technic in Oral Cholecystography and Error Attributable to Technical Failures. B. R. Kirklin, M.D., Rochester, Minnesota.

Five Years' Experience with Oral Cholecystography. Wm. H. Stewart, M.D., and H. Earl Illick, M.D. (by invitation), New York, New York. Discussion to be opened by C. D. Enfield, M.D., Louisville, Kentucky.

X-Ray Dosage. E. T. Leddy, M.D., Rochester, Minnesota.

FRIDAY MORNING, SEPTEMBER 26, 1930.

Radiation in the Treatment of Bone Tumors. George E. Pfahler, M.D., and Leo D. Parry, M.D. (by invitation), Philadelphia, Pennsylvania. Discussion to be opened by H. J. Ullmann, M.D., Santa Barbara, California.

Intravenous Urography. W. F. Braasch, M.D., Rochester, Minnesota (by invitation).

Uterine Hemorrhage Without Demonstrable Pathology. Charles L. Martin, M.D., Dallas, Texas. Discussion to be opened by James T. Case, M.D., Chicago, Illinois.

The Clinical Study of "Colitis" with Special Reference to So-called "Colitis." J. A. Bargen, M.D., Rochester, Minnesota (by invitation). Discussion to be opened by Harry A. Collins, M.D., Des Moines, Iowa.

Ollier's Disease, Unilateral Chondrodysplasia. Report of a Case. Ralph S. Bromer, M.D., and Rutherford L. John, M.D., (by invitation) Philadelphia, Pennsylvania. Discussion to be opened by C. S. Gorsline, M.D., Battle Creek, Michigan.

FRIDAY AFTERNOON, SEPTEMBER 26, 1930

The Roentgen Ray Diagnosis and Localization of Opaque Foreign Bodies in the Air Passages. W. F. Manges, M.D., Philadelphia, Pennsylvania. Discussion to be opened by George W. Grier, M.D., Pittsburgh, Pennsylvania.

Fractures of the Anterior, Superior Border of the Os Calcis due to Indirect Violence. H. W. Dachtler, M.D., Toledo, Ohio. Discussion to be opened by A. L. Gray, M.D., Richmond, Virginia.

Coccidioidal Granuloma: Roentgen Diagnosis. Ray A. Carter, M.D., Los Angeles, California (by invitation). Discussion to be opened by William B. Bowman, M.D., Los Angeles, California.

The Post Pneumonia Lung. Alan L. Hart, M.D., Director Radiological Department Tacoma General Hospital, Tacoma, Washington. Discussion to be opened by H. K. Pancoast, M.D., Philadelphia, Pennsylvania.

DR. HICKEY HONORED

The many friends of Dr. Preston M. Hickey will be interested to know that an honorary degree of Doctor of Science has been conferred upon him by the College of the City of Detroit.

A CORRECTION

In the June issue of the Journal, page 677, appears an abstract of an article by W. W. Wasson on "Bronchosisinusitis Disease." The third from the last sentence reads: "The roentgenogram is not typical." The sentence should read: "The roentgenogram is typical."

## DEPARTMENT OF TECHNIQUE

*Department Editor:* DAVID R. BOWEN, M.D., Pennsylvania Hospital, Philadelphia, Pa.

### AUTOMATIC ELECTRIC HORIZONTAL AND VERTICAL SERIALOGRAPH

By MOSES EINHORN, M.D.

NEW YORK CITY

THE serialograph, a device whereby several roentgen exposures are obtainable on a single film, has been in use now for the past few years. The various types are more or less identical in construction, per-

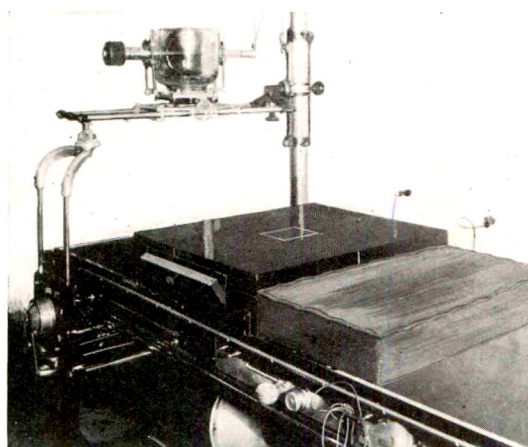


FIG. 1.

mitting from four to twelve exposures to be taken on a film. All of these serialographs necessitate shifting the cassette upon the completion of each exposure.

I have constructed a new serialograph (Fig. 1) which, unlike the others, is automatically operated. It consists of a standard size cabinet, supported by rollers, and can be fitted readily to any roentgen table. Handles attached to either side of the cabinet facilitate its movement to the desired position. The top of the cabinet is lined with lead, with the exception of a small square area  $5 \times 5$  in. which is unlined, in order to permit a penetration of the rays. Protecting the entire surface is a thin layer of bakelite, with markings thereon, corres-

ponding to the square area  $5 \times 5$  in., uncovered with lead.

The cassette,  $10 \times 12$  in., is introduced through a small aperture provided for that purpose on one side of the cabinet. It is held in position by a tray, constructed with a specially devised spring mechanism, which enables the tray to revolve. Beneath the tray is a metal disk, with four notches, each corresponding to one quarter of the circumference of the tray. A lever with a small projection at its outer



FIG. 2.

end is attached to the base of the cabinet. This projection is held tightly to the side of the disk, by a wire spring, which is attached at one end to the lever, and at the other the other end to the disk. An electromagnet is placed behind the lever,

and is connected to an electric current.

Upon pressing a button from a distance, the magnet is electrified, which in turn pulls the lever, enabling the tray to revolve. As soon as the button is released, the current is broken, the magnet demagnetized, and the lever is drawn towards the disk by the attached spring. While the disk rotates, the projection at the outer end of the lever follows its course in the opposite direction, and upon reaching the first notch, causes the tray to stop revolving. Each time the button is pressed, the cassette revolves one quarter of its circumference, and automatically stops, bringing an unexposed quarter of the film directly beneath the marked surface of the cabinet. The entire system is connected with a bell circuit, which rings only while the mechanism is in motion. The vertical serialograph is constructed along the same principles as the horizontal, except that the film is taken vertically.

The model illustrated in Figure 1 is particularly useful in taking a series of

exposures of the pylorus and duodenum (Fig. 2), and may also be used for other parts of the body. This model is designed for a standard cassette 10×12 in., permitting four exposures to be taken on a film. However, it can be modified to take eight exposures, by constructing the disk with eight notches, each notch corresponding to one-eighth of the circumference of the tray, with the unlined area in the form of a triangle, with an angle of 45 degrees and a diameter of 5 inches.

In operating the serialograph, it is necessary to employ a cushion on either side of the cabinet in order to add to the comfort of the patient. However, this model is merely experimental, and can be improved by reducing the cabinet several inches in height, thus eliminating the need of the cushions.

*Advantages:* (1) Shifting of the cassette is eliminated. (2) The apparatus is automatically operated at a distance. (3) The interval between each exposure is shortened.



# INDEX TO ABSTRACTS

## ROENTGEN DIAGNOSIS

### Head

- TESCHENDORF, WERNER: On stereo-projections of the skull..... 203
- TALIA, F.: Roentgen study of the sella turcica in hemorrhagic metropathy..... 203
- GOETTE, K.: The demonstration of the cisternae of the base of the brain and its diagnostic utility..... 203
- BUSTIN, E., LEIST, M., AND PRIESEL, R.: Roentgen studies of the teeth in children. II. The normal set of teeth in children from the eruption of the six-year molars to the eruption of the twelve-year molars... 204

### Neck and Chest

- POTTENGER, F. M.: The early diagnosis of tuberculosis..... 204
- DOUGLAS, BRUCE H., AND PINNER, MAX: Acute subapical versus insidious apical tuberculosis..... 205
- FENGER, E., MATILL, P. M., AND PHELAN, E.: Tuberculous infection in school children.. 207
- OCHSNER, ALTON: Bronchiectasis..... 208
- HELD, A.: Hodgkin's disease of the lungs.... 209
- MILLER, JAMES A., AND JONES, OSWALD R.: Primary carcinoma of the lung..... 210
- POPOVIĆ, LAZA: Remarks on pneumothorax. II 212
- TAMIYA, CHICHIO: On a new principle for the determination of the size of the heart and its practical application..... 213
- SANDERS, ROBERT LEE: Diaphragmatic hernia 213
- OVERHOLT, RICHARD H.: Diaphragmatic hernia. Phrenic nerve stimulation under fluoroscope as an aid in diagnosis..... 214
- GIANTURCO, C.: A case of paralysis of the left side of the diaphragm..... 214
- JENKINSON, E. L.: Diverticula of the esophagus..... 215

### Abdomen

- PODESTA, V.: The roentgen picture of the digestive tract in a case of nervous dyspepsia with pneumatosis of the stomach and chronic meteorism of the small and large intestine..... 215
- MORTON, CHARLES B.: Hypertonicity in hypertrophy of the pylorus in adults..... 216
- STEINBACH, M. MAXIM: Comparative radiographic and anatomical studies of intestinal tuberculosis..... 216
- PODESTA, V.: Abnormalities in the position and size of the cecum and colon..... 217
- WEBER, H. M.: Factors of error in the roentgenologic diagnosis of diseases of the colon 217

- AUCHINCLOSS, HUGH: A clinical study of calcified nodes in the mesentery..... 218
- SCHWARTZ, JOSEPH: Suppuration in the subphrenic region, with special reference to primary idiopathic liver and subphrenic abscess..... 218

### Skeletal System

- LOCKWOOD, I. H., JOHNSON, E. T., AND NARR, F. C.: Hodgkin's disease with involvement of bone and skeletal muscles..... 218
- BÁRSONY, THEODOR, AND KOPPENSTEIN, ERNST: Calcinosis intervertebralis..... 219
- FRIEDRICH, H.: On lymphogranulomatosis (Hodgkin) of bones..... 219
- KIENBÖCK, R.: On the so-called "osteitis fibrosa"—"osteodystrophia fibrosa"..... 219
- WEISS, KONRAD: Osteoporosis circumscripta (Schüller)—a rare but typical form of Paget's disease..... 219
- MADLENER, M. J., AND PAAS, H. R.: On the roentgenologically demonstrated deformities of the knee cap following fractures of the patella..... 220
- JUNGHANNS, HERBERT: The roentgen picture of spondylolisthesis..... 220

## ROENTGEN AND RADIUM THERAPY

- ADLER, KARL: Effect of roentgen and radium radiation on tissue metabolism..... 220
- FREUND, L.: The course of radium reactions on the normal and diseased human skin.. 221
- MAY, E. A.: Roentgen therapy in acute inflammatory conditions..... 221
- TAMIYA, CH., AND Koyama, M.: Roentgen treatment of burns and cauterization of the human skin..... 221
- EWING, JAMES: Factors determining radioresistance in tumors..... 222
- HIRSCH, HENRI: Organotherapy with hipocids, particularly in carcinoma cachexia..... 222
- SEULBERGER, P., SCHMIDT, W., AND KRÖNING, F.: Roentgen studies of carcinoma. I. Cytology and histology after several irradiations..... 223
- RODENBAUGH, FREDERICK HASE: Treatment of malignant tumors of the eye and orbit by radiation..... 223
- QUICK, DOUGLAS: Treatment of malignant growths of the nasal accessory sinuses and nasopharynx..... 223
- SCHULTE, G.: A case of carcinoma of the tongue cured for six years by roentgen treatment alone..... 224



## ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

---

### ROENTGEN DIAGNOSIS

#### HEAD

TESCHENDORF, WERNER. Über Stereo-Projektionen des Schädels. (On stereo-projections of the skull.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1930, 41, 17-34.

In a previous communication the author called attention to the fact that stereoroentgenograms are best obtained in slightly oblique positions. In the present article he discusses the method from the practical standpoint, as applied to the more or less standard positions of the skull.

It was found that in order to obtain a better stereo effect it is necessary to use certain landmarks. On the skull these consist of metal pieces mounted at regular (1 cm.) distances on bands, one of which runs circularly around the head; the second from the forehead to the occiput, and the third transversally across the head. The bands form a sort of a cap, similar to that used for eye-shades. Part of the frontal and occipital portions of the circular band is made of elastic rubber, so as to be able to fit the cap for various skull sizes.

A table is included for the technique of the following more or less standard examinations of the skull: canalis opticus, sella turcica (lateral and oblique), mastoid process, petrous bone (oblique and lateral), base of the skull (from above and below), maxilla and accessory sinuses. The article is illustrated with several roentgenograms fitted for the hand stereoscope.—*T. Leucutia*.

TALIA, F. Lo studio radiografico della sella turcica nelle metropatie emorragiche. (Roentgen study of the sella turcica in hemorrhagic metropathy.) *Arch. di radiol.*, Sept.-Oct., 1929, 5, 841-852.

From 1925 to 1929 the author made roentgen examinations of the sella turcica in all patients who came to him for genital hemorrhage in order to determine whether such hemorrhages are hypophyseal in origin. He studied 41 cases, including 31 of hemorrhagic metritis, 7 of metrorrhagia and ovarian dysfunction and 3 of puberty metrorrhagia. He found that the sella

turcica was larger than normal in 41.46 per cent of the cases, smaller than normal in 14.53 per cent, that it showed the maximum size in 4.87 per cent and the minimum size in 2.43 per cent. He gives the case histories of the 2 cases that showed maximum size of the sella turcica. Both were treated by roentgen irradiation of the hypophysis and both of them improved greatly under the treatment.

He concludes that there is a relation between the hypophysis and genital function, either directly by the size and function of the hypophysis influencing genital function, or indirectly of the nature of compensatory hypertrophy of the hypophysis in genital hemorrhage.—*Audrey G. Morgan*.

GOETTE, K. Über die Darstellung von Hirnbasiszisternen und deren diagnostische Verwertbarkeit. (The demonstration of the cisternae of the base of the brain and its diagnostic utility.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1930, 41, 1-7.

The author injected the cisternae of the base of the brain in cadavers (with a solution of gelatine barex) and compared the roentgen images so obtained with those of encephalograms.

It was found that the injection of the cisterna interpeduncularis and of the fissurae chorioideae has a certain practical value in brain tumors. In this respect the superimposed projection (in a true lateral view) of the fissurae chorioideae is of a true diagnostic value, inasmuch as it permits the detection of changes in size, form, and position of the fissures of the two sides.

It is advised that roentgenograms be taken in at least two positions: one in a strictly lateral, and the other in a slightly oblique position. The procedure of the encephalography (which is done by the cisternal or lumbar puncture) has previously been described by the author in another article. Here it is only mentioned that for a true lateral roentgenogram the patient must be placed in a sitting position with the head erect and the central ray must be directed through the hypophyseal region perpendicularly to the sagittal plane of the

skull. For the oblique position the head is turned with the face slightly away from the film. It is very important that the injection itself be done in the sitting position and that every motion of the skull following the injection be avoided.

In a series of 113 cases, 16 times there was an abnormal position and configuration of the choroid fissures. Two of these cases are described briefly and their roentgenograms presented.—*T. Leucutia*.

BUSTIN, E., LEIST, M., and PRIESEL, R. Röntgenologische Studien am kindlichen Gebiss. II. Das normale kindliche Gebiss vom Durchbruch der Sechsjahr-Molaren bis zum Durchbruch der Zwölfjahr-Molaren. (Roentgen studies of the teeth in children. II. The normal set of teeth in children from the eruption of the six-year molars to the eruption of the twelve-year molars.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1930, 41 49-53.

This constitutes a continuation of an article reported previously. As in the first article the examination was carried out by roentgenograms of the front teeth and of the lower jaws.

After describing in detail the roentgen appearance of the teeth (at yearly intervals) between six and twelve years, the authors arrive at the conclusion that at the age of twelve the lower (and probably the upper) incisors and the six-year molars have reached a stage of complete development. The canine teeth, the premolars, the twelve-year molars (and probably the upper incisors) still show the presence of foramina apicalia. The germs of the lower wisdom teeth lie obliquely in their sacs, at the margin of the horizontal and ascending rami of the jaw.—*T. Leucutia*.

#### NECK AND CHEST

POTTINGER, F. M. The early diagnosis of tuberculosis. *Am. Rev. Tuberc.*, Feb., 1930, 21, 159-182.

The author does not believe that we are making diagnoses as early as we should. Our methods are not keeping pace with our knowledge of the disease.

*The varying aspects of tuberculosis.* Contrary to the teaching of the past, clinical tuberculosis may make its first appearance in any part of the lung, the apex, the base, or anywhere between. The primary focus may be caused by

few or many bacilli, the host may have a varying degree of natural resistance, and the primary focus may result in a low or a marked immunity. We have at one end of the series of cases of early clinical tuberculosis, infections of such a nature that the disease develops slowly and is accompanied by symptoms which are so mild, and have signs which are so insignificant, that they are recognized with difficulty, if at all. On the other hand, we have infections that cause rapidly developing disease with marked symptoms and signs. The symptoms and signs which make it possible to recognize clinical tuberculosis represent departures from the normal in the domain of both anatomy and physiology and the underlying cause of variation is the difference in immunological response brought about by the entrance, growth, dosage, and virulence of the tubercle bacilli in the tissues of various individuals.

*Allergy, the basis of diagnosis.* Allergic reaction is the immediate and principal response of previously infected organisms to all subsequent bacillary inoculations, and it is maintained by the host as long as the body cells remain specifically sensitized to tuberculosis protein. It is this allergic reaction which is responsible for the changes in pathology and symptomatology, the connection and course of the disease process, and the healing or death of the patient. Some patients are infected and healed without the patient being aware of the process. The patient does not become sick unless the numbers of bacilli causing the primary inoculation are sufficiently large not only to produce histological evidence but to produce and liberate the amount of tuberculosis protein into the body fluid that is necessary to call forth an adequate degree of tissue response. The reason why illness promptly follows reinfection when it tardily follows primary infection is known to depend on the fact that the body cells of individuals who have been infected previously possess a new power, namely, that of meeting bacilli or bacillary protein with an inflammatory response.

*Early manifestations of tuberculosis.* If the implantation of small numbers of bacilli were repeated sufficiently often, quantities of tuberculosis protein sufficiently large to stimulate the immunity mechanism would set free and cause an allergic reaction sufficiently marked at least to increase fibrosis about the original

focus which might result in healing where it had previously failed. This might occur without producing recognizable symptoms. If the number of bacilli implanted in new tissue were greater but still comparatively few, and the immunity of the host at the time was at a low ebb, the spread of the disease might take place before the immunity mechanism could be raised to a point necessary to successfully combat it. If, however, immunity was already established, an allergic response might follow sufficient to cause a varying degree of exudation and local injury to the cells. In the former condition widespread disease might develop without marked physiological disturbance. In the latter there would be a quick response and almost immediate symptoms. By understanding that tuberculosis makes its presence known by setting the immunity mechanism of the host into action and that the allergic inflammatory reaction is its most evident expression, it devolves upon physicians to familiarize themselves with this reaction so that it may be recognized.

The entire organism is subject to the reaction of the allergic response in three ways: (1) through the toxins; (2) reflexly; (3) locally in the tissues subject to the inflammatory process.

*Toxins disturb the general physiological balance.* Reflexly, the implanted pulmonary tissues disturb the physiological balance. Locally the allergic reaction may cause an increased permeability or a rupture of the walls of delicate capillaries which may result in hemoptysis, an increased secretion of the bronchial glands, an exudate into the air spaces, or a limited caseation followed by destruction of tissue with appearance of bacilli in the sputum.

*Examination of the patient for early clinical tuberculosis.* The author divides the symptoms occurring from each one of these allergic manifestations into certain groups and discusses them fully. The toxic symptoms may appear and disappear quickly. They may be severe and of short duration, or may be continuous over long periods of time. The reflex group remain as long as the inflammation exists in the lung.

*Physical examination.* Under this heading the author discusses at length inspection, palpation, percussion, and auscultation, calling attention to the importance of recognizing slight changes in the spasm of muscles, atrophy

of skin, etc. He reviews the physiology that will cause the various changes. The roentgen changes are discussed briefly. He states it stands to reason that the mild reaction may be wholly missed by the roentgenogram while the severe reaction casts definite shadows. He goes into the matter of why various types of lesion absorb the rays and cast a shadow on the roentgenogram, and what changes in the lung constitute activity. The atomic weights of the different elements in the lung are given. The author states that an exudative or parenchymatous lesion should always be interpreted as being active, but it would be unwise to interpret the absence of such a lesion as positively meaning the absence of active disease.

Examination of the sputum and discussion of the tuberculin test receive some attention. The tuberculin test is the test for general cellular hypersensitiveness, the presence of tuberculo-allergy, as this affects the body cells, both surrounding and at a distance from the foci of disease. The presence of cell hypersensitiveness to tuberculin means the presence of an infection with Koch's bacillus at the time or at some time in the past. The test does not give one any idea about the activity of the process.—*E. P. Pen-dergrass.*

DOUGLAS, BRUCE H., and PINNER, MAX.  
Acute subapical versus insidious apical tuberculosis. *Am. Rev. Tuberc.*, March, 1930, 21, 305-326.

*Pathogenesis and clinical significance.* Attention has been called to certain forms of tuberculosis in the German and French literature during the past few years but very little mention of these forms has been made in American or English literature. The onset of clinically demonstrable tuberculosis is frequently associated with suddenly appearing grippe-like symptoms and this symptomatology is apparently caused by a quickly developing infiltrating (bronchopneumonias) lesion whose localization is most frequently in the infra-clavicular region.

*Definition.* The authors have divided pulmonary tuberculosis into acute subapical and insidious apical types. It is their belief that diagnostically, symptomalogically, prognostically, and therapeutically, "acute subapical," and "insidious apical" tuberculosis are so significantly different that for the matter of

quick understanding their terminological differentiation is highly desirable. When they speak of clinical types of tuberculosis they have endeavored to differentiate the disease very much as Osler would in speaking of abortive, grave, and ambulatory forms of typhoid fever. They feel that the present terminology is entirely unsatisfactory.

*Relation of acute subapical foci to primary foci.* Designating "acute subapical" foci as a frequent incipient stage of clinical pulmonary tuberculosis does not involve any judgment about the time of primary infection. In many patients with such acute lesions the roentgenograms bear witness that at some unknown time the patient acquired his usual primary infection. An intrathoracic primary complex is frequently present without producing roentgen evidence. Whether the acute pulmonary infiltrations may occur in virgin soil or whether they require an allergic territory for the development is open to speculation. It is probably safe to assume that infiltrative lesions in question are as a rule foci of reinfection and not primary lesions since it has never been reported that they show the picture and course characteristic for primary lesions, namely, healing by calcification and ossification and simultaneous involvement of the regional lymph nodes.

*Relation of "acute subapical" foci to apical foci.* The apical fields may be the seat of traditional nodular lesions and scars, or excavated acute infiltrations, of old isolated cavities and of primary foci. Every apical lesion should be judged on its own merits. The authors are concerned in this discussion with apparently healed nodular foci and scars in the apices only, which do not give rise to definite symptoms beyond those of phthisis phobia. For such lesions frequently described as minimal tuberculosis or even as "incipient tuberculosis" they claim that they are not the forerunners of progressive pulmonary tuberculosis in an incipient stage of this disease, and that the diagnosis and treatment of such cases will not prevent progressive lesions. They must be considered as obsolete foci whose active stages pass unnoticed. All clinical evidence points to the assumption that most apical foci develop without clinical symptoms or with symptoms of very slight degree and insidious nature. Pathological and roentgen evidence suggests that they are usually

acquired in late childhood or adolescence. Their actual pathogenesis, endogenous, hematogenous, metastasis from the primary lesion, or exogenous, erogenous superinfection,—is still the subject for theoretical debate. According to Aschoff more than 90 per cent of all adults show, at autopsy, not only a primary complex but evidence of re-infections as well, the vast majority of these re-infection foci being found in the apical fields. It is the task of the clinician and roentgenologist to recognize the incipency of manifest disease, but it is evidently impossible to treat prophylactically upward of 90 per cent of all adults because of their having apical scars, demonstrable or not. Many so-called prophylactic measures are but wasted efforts, because they are motivated by the unattainable aim to diagnose the disease before it really exists. To build up general health and promote better living conditions, are good preventive medicines, but to tell the person that he is threatened by pulmonary tuberculosis and to treat him prophylactically means that the actual disease has not been recognized or it is a statement unsupported by facts and knowledge. The authors' concept, therefore, is that apical scars cannot be considered as the inception or forerunner of progressive pulmonary tuberculosis any more than the primary foci; the true clinical incipency of manifest disease is very frequently marked by the sudden appearance of infiltrative foci.

*Pathogenesis and pathology of "acute subapical" infiltrations.* Theoretically the acute infiltrations may be produced by exogenous inhalation infection, by hematogenous spread from the primary focus or from re-infection foci (apical scars) if present, or by bronchogenic spread from apical foci. Aschoff's studies in accordance with Huebschmann's indicate that each focus of re-infection starts with an exudative phase, regardless of localization and size of re-infecting dose; all re-infection foci are pathogenetically applied, in that all start as Frühinfiltrate. It is of great practical importance to distinguish between traditional teaching and the new knowledge. According to traditional teaching, insidious onset with chronic, insidious symptomatology and slow, gradual progress represents lesions whose incipient stage required all of the skill of clinicians and roentgenologists to discover; according to the "new teaching" there is a sudden onset with mostly



marked, though frequently misinterpreted, symptoms, a progress characterized by acute exacerbations and periods of chronic intermission, and with initial lesions whose roentgenographic demonstration, at least, is no problem requiring specially refined technique.

*Clinical significance of "acute subapical" foci.* The authors stress the point that they have never seen a single series of films showing the slow apico-caudal progress of strictly apical foci without the intervention of acute infiltrations. However, they have seen cases whose first demonstrable lesions consisted of multiple small and apparently exudative foci scattered more or less regularly throughout one or both pulmonary fields. Such lesions are probably pathogenetically developed from the isolated acute infiltration; they suggest strongly hematogenous origin; they show less tendency to extensive caseation; if they heal, calcification plays a more important rôle in them than in other lesions in adults, but the pathology of the individual early lesion is probably not different from that of a more massive isolated acute infiltration.

*Diagnosis of acute infiltrations and of apical lesions.* In spite of the amount of work that has been done on the early diagnosis of pulmonary tuberculosis it is still true that the vast amount of persons found to have the disease are suffering from it in an advanced form. This is due to the fact that the patient looks upon himself as a sufferer from just a cold or possibly influenza so that when the symptoms are sufficiently severe to cause him to seek medical advice the disease has become very advanced. In order then to recognize the disease in its incipency it is wise to consider every undue protracted cold, or every attack of influenza as a possible acute onset of pulmonary tuberculosis. The physical findings are discussed at length and there is also discussed thoroughly the diagnostic aid of the laboratory from sputum examinations and blood counts. Cough and expectoration are explained. The finding of tubercle bacilli in the sputum is of diagnostic value. Blood counts are only of value on the day they are taken. A relatively high white count, a slight leucocytosis, and a slight shifting to the left indicate a still unstable and probably progressive lesion. Return to normal or a lymphocytosis is usually associated with a lesion which is stationary or undergoing a fibrosis.

The extent of the lesion, its pathologico-anatomical nature, the absence or presence of cavities, and local and general signs and symptoms of activity constitute traditionally the essential data for a complete diagnosis of pulmonary tuberculosis. The time factor is of high practical importance, particularly in regard to prognosis and therapeutic indication. Thus two lesions presenting the same appearance in all diagnostic respects are distinctly different in their potential developments if one has existed twice as long as the other.

*Further developments of acute infiltrations.* Under this heading the authors discuss and give excellent examples illustrating; (1) resorption; (2) fibrosis; (3) caseation and excavation.

1. This excellent paper is summarized in stating that it is justifiable to attempt to differentiate infiltrative *subapical* and nodular *apical* tuberculosis.

2. Clinical and roentgenologic character of the infiltrative subapical tuberculosis does not explain the nature of its beginning or of its relation to the primary infection of the individual.

3. The evidence strongly points to the conclusion that nodular apical tuberculosis is not an incipient lesion but is a more or less benign process of long standing but with little or no tendency to progress.

4. The infiltrative subapical lesion, however, is usually of quite recent origin and is potentially more grave from the standpoint of progression.

5. The chronic apical lesion tends to be a nodular, productive one, whereas the subapical tends to be an infiltrative one and is probably an acute exudative lesion.

6. Every effort should be directed toward the early recognition of the acute subapical type; the diagnosis resting upon: (a) the history of an acute onset or exposure; (b) presence or absence of physical findings in the lung; (c) roentgenogram of the lung; (d) painstaking examination of the sputum.—E. P. Pendergrass.

FENGER, E., MATTILL, P. M., and PHELAN, E. Tuberculous infection in school children. *Am. Rev. Tuberc.*, Feb., 1935, 21, 183-194.

The authors have studied the incidence of tuberculous infection in children attending city

dispensaries and hospitals where they are receiving treatment for some known tuberculous infection. In this article the authors review the findings of many authors who have been interested in this problem. Their studies included the roentgen examination and the tuberculin reaction in addition to the clinical studies. Their conclusions are as follows:

1. The incidence of tuberculous infection in school children in the rural Hennepin County, Minn., is much lower than that usually reported.

2. The "questionable positive" group may report an infection that is of such low grade that it gives no appreciable reaction or it may represent a once active infection that is dying out.

3. The markedly positive group represents those cases having received recent or repeated infections.

An effort should be made to find the source of infection wherever it is not known. These children should be given special attention so that they will not develop manifest tuberculosis as they pass through childhood to adolescent maturity.

4. The high incidence of tuberculous infection in the contact cases is again shown.

5. Nutrition does not seem to be predisposed to infection nor does it necessarily follow after infection has taken place.

6. Roentgenograms are essential in determining pulmonary involvement in infected cases. There is a complete correlation between the positive reactors and the findings on the roentgenograms. Nevertheless, the authors feel that the roentgenograms give much valuable information and that films should be taken on at least all of the positive reactors.—*E. P. Pendergrass.*

OCHSNER, ALTON. Bronchiectasis. *Am. J. M. Sc.*, March, 1930, 179, 388-405.

The author states that bronchiectasis is the most frequently encountered chronic pulmonary condition in his personal experience, and he states that because of the persistent cough which resists all forms of therapy it is often treated as tuberculosis, in spite of reported negative sputum. Bronchiectasis may be caused by tuberculosis but it is rare.

The etiology of bronchiectasis is varied. Some believe it to be due to congenital cystic

changes in the lung; others believe rhosis of the lung may play an rôle. Chronic pneumonia has been mentioned as a cause. Acute infectious diseases chronic sinusitis may cause bronchiectasis. Bronchiectasis has been attributed to a loss of nerve control of the bronchi; to obstruction of bronchus by stenosis; to congenital narrowing; to inspired foreign bodies or to neoplasm. Of the varied causes chronic bronchitis is the most important.

In a discussion of the pathological anatomy three types of bronchial dilatation are described: (1) cylindrical; (2) fusiform, and (3) saccular. The latter type has been described as the congenital type. Dilatation may occur in the bronchi, bronchioles or both. In the early stage there is a hypertrophy of the mucosa of the bronchi and bronchioles as well as hypertrophy of the peribronchial obstruction. There is a catarrhal swelling of the mucous membrane. Desquamation of epithelium may result in hemorrhage and there may be calcification of degenerated portions especially in the region of the cartilage. In advanced stages an atrophic form is described where entire bronchial wall is replaced by fibrous tissue, and the tissue surrounding the bronchi shows fibrosis and atelectasis. The author states that bronchial dilatation, in all probability, precedes any anatomic change, and that by far the greater number of cases of bronchial dilatation which are clinically improved by the introduction of iodized oil into the tracheobronchial tree have relatively little anatomical change in the bronchial wall. Bronchial dilatation may be due to atony of the musculature, secondary to bacterial toxins, aided by stagnation of retained secretions. The lower lobes are most frequently involved, the left more frequently than the right. The reason for the latter is unknown. The clinical picture described in textbooks is that of late stage. The signs of early bronchial dilatation or bronchiectasis are relatively insignificant with or without sputum. The diagnosis in each case was made bronchographically. The sputum, if present, is rarely fetid and posture may result in sputum in the so-called cases of dry bronchiectasis. The cilia are lost early in the disease. Hemoptysis is present in from 50 to 70 per cent but is often small in amount. Slight lassitude is present in some cases and

occasionally there are vague symptoms, resulting in the patient being classified as a neurotic. Bronchography has been a great aid in the diagnosis. In early cases the physical findings are minimal. There is slight lagging of the affected side with no change in percussion and only a few râles to auscultation. In advanced cases the clinical signs are well marked.

The introduction of iodized oil into the tracheobronchial tree in conjunction with roentgen studies has facilitated an early diagnosis of bronchial dilatation or bronchiectasis. The only symptom present in many of the author's cases was cough. Fluoroscopic study of the introduction of the oil is important because these dilated bronchi may be obscured by the filling of superimposed bronchi.

In the medical treatment the results are more or less unsatisfactory. The surgical treatment is varied. At the present time surgical collapse is most widely practised but it is not to be considered a curative measure. The form of collapse used may be either artificial pneumothorax or thoracoplasty. Evulsion or division of the phrenic nerve on the affected side has given good results. Lobectomy has not been very successful, because of the high mortality.

At this present time the medical treatment consists chiefly of postural drainage, intratracheal injections and in some continental clinics dehydration. Vaccine therapy has shown no results. The author has found intratracheal injections of iodized oil to have beneficial effects in bronchiectasis. He has found a decrease in the number of organisms in the sputum following these injections and a parallel clinical improvement of the patient. Experiments performed in vitro show iodized oil to be not bactericidal, but this cannot be compared with those obtained clinically. The author states that there are no untoward effects from intratracheal injection of iodized oil. A few cases may show iodism which lasts only forty-eight hours. No pathological changes have been demonstrated as a result of this procedure. Iodized oil should be used cautiously in pulmonary tuberculosis.

The author obtained a symptomatic cure in 32 per cent of all his cases, and caused the bronchial dilatation to disappear in 4 cases. He states that in all cases there no doubt was

only a fractional dilatation of the bronchi. In 96 per cent of the author's cases there was a return of symptoms following a second upper respiratory infection, which were not as severe as before treatment and responded quickly to additional treatment. In the remaining 32 per cent there was marked improvement. The ultimate result of this treatment is not as yet known but the high percentage of improvement shown in this author's series of cases makes this mode of treatment satisfactory if the iodized oil can be introduced without discomfort to the patient and the author describes his "passive technic" for accomplishing this.—*E. P. Pendergrass.*

HELD, A. Die Hodgkinsche Krankheit der Lungen. (Hodgkin's disease of the lungs.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Feb., 1930, 41, 191-206.

Thirteen cases of Hodgkin's disease with involvement of the lungs are briefly described and their roentgenograms presented.

On the basis of the roentgen appearance, the author distinguishes the following four groups: (a) simple mediastinal lymph node tumors; (b) mediastinal tumors with direct extension to the lungs; (c) distinct lung processes in addition to the mediastinal tumor, and (d) disseminated forms. This classification is somewhat arbitrary for transitional forms of all types may occur.

Differential diagnosis includes the true mediastinal and pulmonary tumors, the malignant metastases to the lungs and tuberculous processes.

The conclusion is reached that the intrathoracic manifestation of Hodgkin's disease shows no characteristic roentgen appearance. Since the condition is merely a local manifestation of a generalized systemic disease, various forms of invasion may be encountered. The question is further complicated by the fact that the application of roentgen therapy may entirely change the picture and produce an entirely different roentgen aspect of the disease.—*T. Leucutia.*

MILLER, JAMES A., and JONES, OSWALD R. Primary carcinoma of the lung. *Am. Rev. Tuberc.*, Jan., 1930, 21, 1-56.

This is a presentation of the clinical aspects of primary carcinoma of the lung, which may more properly be designated as primary bronchial carcinoma. The literature on the subject

is reviewed from 1911 up to the present time and 32 definitely substantiated cases, never before recorded, are presented.

The history of pulmonary cancer shows that it was almost an unknown entity until the 19th century, when it was recognized with the development of studies in pathological anatomy. Bayle, in 1810, seems to have been the first one to actually recognize pulmonary cancer as such. Stokes, in 1837, was the first to use percussion and auscultation for the direct demonstration of pulmonary cancer during life. He gave such a full description of the clinical diagnosis of this disease that the writers following him for some years had very little to add to it. In 1853 Virchow published his masterful studies of pulmonary tumors, which are the basis of our modern conception of this pathological condition. In 1911 Adler made an exhaustive survey of this disease in his classical publication on this subject, and since that time a great many authors have discussed different phases of primary pulmonary neoplasm.

As to the incidence of this disease, Carman states it to be his belief that cancer of the lung represents 1 per cent of all cancer and 2 per cent of deaths from all forms of pulmonary disease. Statistics do not bear out the belief that the disease is on the increase. In relation to sex, the condition is found more frequently in men than in women, in the proportion of 3 to 1, while the average age incidence, according to Hauf, is fifty to fifty-four. McCrae et al., state that 91 per cent of all cases are past thirty-five years of age.

Many theories have been advanced to account for the origin of pulmonary cancer, but little is actually known. Most authors agree in laying emphasis upon chronic irritation of the bronchial mucosa as one of the underlying causes. Among the etiological factors advanced by various authors are overgrowth of a fetal bronchiectasis, atelectatic pulmonary tissue, tuberculosis, influenza and irritation from dust.

Pathologically the disease is divided into three main groups:

1. Carcinoma of the lining epithelium of the bronchi.
2. Carcinoma of the mucous glands of the bronchi.
3. Carcinoma arising from the pulmonary alveoli.

In addition to the primary lesion the condition is often complicated by secondary lung changes such as atelectasis, bronchiectasis, necrosis and pleural thickening. Inflammatory changes, such as an exudative pneumonia, or an interstitial pneumonitis and a secondary pleural effusion, either serous, bloody, or purulent, is frequent. Abscess formation and necrosis of the growth are common occurrences.

Metastasis in 808 cases collected from the literature occurred most frequently in the pleura, the liver, regional and remote lymph nodes, other parts of the lungs and the kidneys, in the order given. From the clinical point of view, emphasis should be placed upon the frequency of metastasis to the bone and the brain.

Under the heading of clinical manifestations is given an analysis of the symptoms occurring in primary carcinoma of the lung. Cough is the most frequent symptom, the sputum is not characteristic; hemoptysis is a very frequent and important symptom occurring in more than 50 per cent of the cases. Dyspnea is present in about half the cases and probably starts early in the disease. Pain is a very uniform accompaniment and next to the cough is regarded by most authors as the most common symptom. Secondary metastases to the lung seldom cause pain. Cyanosis, stridor, hoarseness and dysphagia are symptoms usually arising from involvement of the mediastinal lymph nodes late in the disease.

Of the systemic manifestations fever is the most common. It is important from a diagnostic point of view frequently leading to a diagnosis of inflammatory rather than a neoplastic disease. Loss of weight, weakness and cachexia are late symptoms. Osteoarthritic changes may occur.

In the symptoms due to metastasis pain is of prime importance. Other symptoms are dependent upon the localization of the metastasis.

The physical signs of pulmonary carcinoma are varied and not pathognomonic. The diagnosis must often be made in the absence of physical signs.

The evidence offered by a roentgen examination of the chest is the most valuable single means of determining the presence and location of a pulmonary tumor. The character-



istic appearances, however, are often marked by secondary changes, making differential diagnosis difficult. Not alone in diagnosis but in prognosis serial roentgenography is of extreme value.

If sectioning of the tissue which may be obtained directly from the tumor or from a metastatic deposit be excluded, the laboratory aids comparatively little in the diagnosis of this disease.

In all cases of chronic pulmonary disease in which the diagnosis is obscure, examination by means of the bronchoscope is becoming more and more an important factor. The authors believe that the diagnosis of early bronchial carcinoma can only be positively established by this method.

The authors have endeavored to simplify the confused picture of primary bronchial carcinoma by classifying the cases usually encountered into ten clinical types distinguished by their pathology, symptomatology, physical signs, roentgen and bronchoscopic findings.

*Type 1.* This tumor is intrabronchial, arises entirely from the wall of the bronchus, and is manifested early by cough and blood spitting. Physical signs usually absent. Roentgen examination is negative. Diagnosis is made by bronchoscopic examination. The recognition of this early type of disease is extremely important, as it is one of the few at the present time amenable to successful treatment, which is by bronchoscopic removal.

*Type 2.* The peribronchial form of lesion, later than Type 1, in which there is infiltration commencing in the lining membrane of the bronchus and extending into the parenchyma of the lung. Roentgen picture fairly typical, showing the densities along the roots of the lung with radiations out into the parenchyma. The diagnosis can often be confirmed by bronchoscopic examination.

*Type 3.* The solitary nodule tumor, in which the lesion consists of a rounded, sharply outlined tumor mass located far out in the lung field in the roentgenogram or close to, and connected with the hilus by a thin band of infiltrated tissue. The origin may be bronchial or alveolar. This type is quite rare and is usually benign rather than malignant.

*Type 4.* The scirrhus type of the disease, occasionally seen. This lesion may result from bronchial obstruction by infiltration of the

growth causing collapse of a lobe with subsequent fibrosis, or it may be due to an infiltrating tumor which does not obstruct the bronchus, but causes the production of fibrous tissue reaction with resulting shrinkage of the lobe involved. This lesion is usually an epithelioma arising either from the metaplasia of the bronchial epithelium, or sometimes from an old tuberculous process. Symptoms are more marked, generally pain and dyspnea and frequently fever. Physical signs show retraction and diminished expansion of involved portion of chest. Marked dullness, tubular breathing or absence of breath sounds. The roentgenogram shows a dense shadow with a concave lower border that has a sharp line of demarcation. Slow growth, metastasizes slowly, may be mistaken for tuberculosis. It is the type which might be considered possibly curable by means of radical surgery.

*Type 5.* The mediastinal phase of the lesion, more advanced but of the same nature as Type 2. The physical signs are usually found in the interscapular region and consist of slight dullness with diminished breath and voice sounds and occasionally a few râles. The roentgen picture is very definite, showing a rounded, dense shadow extending out from the hilus.

*Type 6.* The massive consolidation stage in which the tumor densely infiltrates the entire lobe or a large portion of one lobe. Pleura frequently involved. Pain is an associated symptom. Physical signs similar to those of Type 5. The roentgenogram shows a lesion usually in the upper lobes, invariably limited by the interlobar septa, giving a shadow of a density which rarely obscures the ribs and diminishes in density toward the apex and the periphery. The diaphragm is usually high.

*Type 7.* In this phase there is massive consolidation with abscess formation. Among the symptoms are a very profuse, often foul, expectoration, and almost always septic fever. The physical findings and roentgen appearances are those of pulmonary abscess.

*Type 8.* This is the bronchial obstruction stage in which the stem bronchus leading to the lung or one of its lobes is obstructed. Before this becomes complete many pathological changes may occur, such as bronchiectasis, thickening of the pleura, pleural effusion and necrosis of the lung parenchyma. With com-

plete obstruction, massive atelectasis occurs. The symptoms and physical signs are those characteristic for the various changes enumerated, eventually terminating in those of atelectasis. By frequent roentgen examination the development from partial to complete bronchial obstruction is readily followed.

*Type 9.* A curious and rather unusual type in which the tumor is disseminated along the course of the main bronchus in the form of patchy areas of infiltration with small, rather discrete nodules. Physical signs are those of bronchopneumonia of a portion of the lung. The roentgenogram shows numerous small patchy areas of density along the main stem bronchus. The diagnosis is difficult. It is usually made by watching the disease develop. The bronchoscope is less apt to help in the diagnosis, as the lesions are frequently too far down the bronchial tree.

*Type 10.* That of miliary carcinosis in which there are small miliary areas of carcinoma distributed throughout both lungs. The literature reveals only a few authentic cases. Physical signs are those of a diffuse bronchitis or a patchy basal pneumonia. X-ray very closely resembles confluent miliary tuberculosis or if the areas are large, some cases of bronchopneumonia.

The progress of modern surgery is beginning to make the early diagnosis of bronchial carcinoma a matter of serious importance to the life of the patient. In Types 1 and 3 and possibly in Types 2 and 4, an early diagnosis might lead to possible radical cure by surgery. Type 1 can be removed through the bronchoscope.

The differential diagnosis of the various types of lesion is given. Primary bronchial carcinoma may at times simulate any form of pulmonary disease. Tuberculosis is the most frequent. Roentgen and bronchoscopic examinations offer the best means of establishing the diagnosis.

Among the types described in Types 1, 2, 3 and 4 metastasis is relatively slow and inasmuch as these types are the ones for which, theoretically, something might be done in the way of treatment, their early recognition becomes particularly important. In general, the prognosis of the disease is uniformly bad. Death usually occurs from three to fourteen months after the appearance of definite symptoms.

Under treatment the following methods are considered preventive: roentgen ray, bronchoscopic and radical surgery. Little can be done in the preventive treatment until more exact knowledge concerning etiology is at hand. Until then, all forms of lung irritation such as infection and dust inhalations must be guarded against. The main treatment at the present time is symptomatic.

Roentgen treatments, in the authors' experience, have not arrested the progress of the disease. It may at times relieve pain and prolong the patient's life. It is contraindicated where there is obstruction of the bronchus with atelectasis, as in these cases the symptoms are aggravated and predispose to necrosis and abscess formation.

In the very early cases, bronchoscopic removal of the lesion offers the best hope of ultimate cure. Bronchoscopic drainage may also be used palliatively in the more advanced cases. With the rapid strides being made in thoracic surgery, it may be expected that cures may result from this form of treatment if the cases are seen sufficiently early.

Summaries of the 32 proved cases are given.  
—Karl Kornblum.

POPOVIĆ, LAZA. Bemerkungen zum Pneumothorax. II. (Remarks on pneumothorax. II.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1930, 41, 57-61.

The author performed a series of experiments in rabbits and dogs in order to determine the mechanism of the intrathoracic injection of air in pneumothorax. The following four stages were distinguished: (1) the formation of air bubble which was of a very short duration and which due to the resistance of the inflated lungs soon transformed into (2) an air disc; (3) total compression of the lung, and (4) total collapse of the lung.

The technique of the experiments was as follows: the animals were killed with chloroform or cyanide of potassium; a window was cut in the side of the thorax and a celluloid plate provided with a tight fitting injecting needle was inserted in the window. The lungs (which collapsed when opening the thorax) were then inflated and the mechanism of injection of the air actually observed. In some instances lipiodol was used in place of air.

It was attempted to carry out the experiments also in living animals but so far they have been unsuccessful.—*T. Leucutia*.

TAMIYA, CHICHIO. Über ein neues Prinzip für Grössenbestimmung des Herzens und seine praktische Anwendung. (On a new principle for the determination of the size of the heart and its practical application.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1930, 41, 62-66.

The usual methods for the determination of the size of the heart consist (1) in teleroentgenography with films at 2 meter distance, and (2) in the well-known Groedel's method.

The author devised a new method which he calls orthophotography and which is based on the principle that a specially constructed tube emits roentgen rays in two opposite directions, one beam being used for the actual roentgenoscopy while the other registers the findings on a roentgen film mounted on the back of the tube box.

The tube, which is a "bicathode" tube, is constructed in such a manner that both endings serve as anodes and the cathode (which has two parallel surfaces and is suspended in the center of the tube by a mounting to the side of the tube), functions alternately as target for the electrons emitted from the two anodes. The one surface of the target directs the beam forward to the roentgenoscopic screen, while the other surface directs an identical and exactly parallel beam backward to the roentgen film. This permits the tracing of the borders of the heart on the screen (orthodiagraphy) and their simultaneous registration on the roentgen film (orthophotography).

In the above procedure the tube is run alternately for the two target surfaces. This is accomplished by means of a special connection of the valve tubes (the machine is valve rectified), half of the wave being directed to one anode, and the other half to the other anode. However, if so desired, the tube may be run continuously by a simple switching (rearrangement of the connection) of the valve tubes, with either of the two target surfaces, thus permitting the performance of roentgenoscopy, teleroentgenography, as well as all the usual roentgenographic examinations with the same apparatus.—*T. Leucutia*.

SANDERS, ROBERT LEE. Diaphragmatic hernia. *Ann. Surg.*, March, 1930, 91, 367-380.

Attention is called to the increasing frequency of the recognition of diaphragmatic hernia since the general use of roentgen examinations, many cases without symptoms being found accidentally. The congenital type may become manifest at any age, and when trauma is the cause, years may elapse between the injury and the onset of symptoms.

The congenital cases are caused by a failure of the component parts of the diaphragm to meet and unite. If it develops before the membranous diaphragm is complete there will be free communication between the thoracic and abdominal cavities. The hernia will be without a sac. If it develops after the diaphragm has formed there will be a sac composed of the opposed layers of pleura and peritoneum. In the first type there is less danger of strangulation, the organs acquiring a tolerance to their crowding and being freely movable. The second type may not develop until long after birth, the rapidity depending on the size of the defect and any unusual strain. Both types are more frequent on the left side. Enlargement of one of the natural permanent openings permits the formation of a slightly different type of congenital hernia. A congenital shortening of the esophagus or the failure of it to attain adult length on account of cicatrices resulting from swallowing corrosive substances in infancy or early childhood may cause a portion of the cardia to remain above the diaphragm.

Of the acquired types, the most frequent are the cases due to gunshot, shell or stab wounds of the diaphragm. Accidental slitting of the diaphragm during thoracic operations has been reported in several cases.

In both types of cases the migration of the abdominal viscera up through the aperture, against gravity and anatomic anchoring, is caused by the difference in pressure between the two cavities, a combined influence of pressure and suction with each breath.

The symptomatology, referable to the respiratory and circulatory systems on one hand, to the gastrointestinal system on the other, varies with the location of the hernia, with the organs involved and their condition. Symptoms may be absent or may vary with the fullness of the herniated viscera, the position of the patient and the size of the opening. Strangulation

may occur. Especial danger is present during pregnancy and labor. Four cases of the author are presented.—*P. A. Bishop.*

OVERHOLT, RICHARD H. Diaphragmatic hernia.

Phrenic nerve stimulation under fluoroscope as an aid in diagnosis. *Ann. Surg.*, March, 1930, 91, 381-391.

This paper discusses the differential diagnosis between diaphragmatic eventration and hernia with some remarks about the technical procedure in the treatment of the latter condition.

In hernias where the protrusion through the diaphragm is a large one, the dome of the hernia may give the same roentgen appearance as that seen when the diaphragm itself has assumed an abnormally high position. To this latter condition the terms eventration, diaphragmatic insufficiency, elevation, relaxation, "hochstand," etc., are applied. It is explained as being due to a degenerative or congenitally defective musculature or a paralysis of the phrenic nerve. In eventration the viscera and the diaphragm are forced upward by the difference in thoracic and abdominal pressures in the same manner as in herniation. The thin line separating the pulmonary tissue from air collections in the stomach or colon in eventration is due to the thin diaphragmatic partition, while in hernias it is due to the sac or the visceral walls.

The two conditions are found to be repeatedly confused in the literature due to similarity of physical signs, symptoms and roentgen findings. Differentiation is important from the standpoint of treatment.

The following methods have been applied in making a differential diagnosis:

1. *Movements of the Costal Margins.* Normally the outward excursion of the costal margins is limited by the pull of the diaphragms. In cases of eventration this effect is limited or absent and a more noticeable excursion is permitted on the involved side. In some cases of hernia in which there has been a wide separation of diaphragmatic musculature this test is not reliable.

2. *Roentgenoscopic Signs.* In eventration the diaphragm produces a thin, smoothly curved shadow which is highly placed in the lower thorax. In hernia this line may be irregular. Some observers have called attention to the

absence of lung markings behind the elevated diaphragm in cases of eventration. Paradoxical diaphragmatic movements may or may not be present in either condition. This also applies to shifts in the mediastinum during respiration. A barium meal usually presents valuable findings. Carman and Fineman have pointed out that in hernia the meal may assume a higher level than the cardiac orifice, while in eventration it will never go above that point. Repeated examinations often show in cases of hernia an altered picture, while in eventration the findings are uniform.

3. *Intragastric Pressure Studies.* In hernia cases, the pressure in that portion of the stomach which is in the chest varies in accordance with the pressure variations within the intrapleural sac. If the stomach is still in the abdomen, as in cases of eventration, the findings should be normal, i.e., the intragastric pressure curve rises with the descent of the diaphragm and falls with its ascent.

4. *Pneumoperitoneum.* This method has been used by Verbrycke and others.

5. *Laparotomy.* Operation has been thought to be justified in some cases to definitely establish a diagnosis.

6. *Faradization of the Phrenic Nerve.* By exciting the phrenic nerve on the affected side, a response of the diaphragm can be seen under the fluoroscope. In eventration this fails to cause a contraction.

A case is reported and illustrated in which a differential diagnosis was made by the use of this method, all others being inconclusive. The bibliography contains 39 references.—*P. A. Bishop.*

GIANTURCO, C. Un caso di paralisi del diaframma sinistro. (A case of paralysis of the left side of the diaphragm.) *Arch. di radiol.*, Sept.-Oct., 1929, 5, 891-896.

A peasant twenty-seven years of age came for examination on account of epigastric pain which radiated to his left shoulder on eating. The pain began about six months before, about three months after he had recovered from a left pleurisy, and had increased since. He sometimes had retching but no vomiting; no melena, no icterus, no fever. He was pale and in a poor condition of nutrition. Roentgen examination showed a large shadow in the region of the left hilus



probably caused by enlarged glands, paralysis of the diaphragm on that side, the left half of the diaphragm rising 6 to 7 cm. higher than the right and showing paradoxical movement, displacement of the heart to the right and cascade stomach with exceptionally rapid emptying time. The paralysis of the diaphragm was probably caused by the phrenic nerve being caught in the enlarged glands at the hilus.

This was probably an eventration of the diaphragm due to paralysis of the phrenic nerve, though it showed the paradoxical movement supposed to be characteristic of hernia as well as the double line of the arch seen in eventration. There was also variability of the organs contained in the arch but the author thinks this may occur in eventration as well as in hernia, particularly as adhesions are apt to occur at the hernial opening. Cascade stomach is frequent both in eventration and hernia of the diaphragm and is attributed to rotation of the stomach around the cardia because of the aspirating action of the thorax, and to the upward and backward push of the colon on the anterior surface of the organ. Both these factors were probably active in this case as the stomach appeared to be rotated on its axis and astride the colon. The rapid emptying may have been caused by pressure similar to that exercised on the phrenic by the enlarged glands, or it may have been due to the changed form of the organ affecting the function of the pylorus.—*Audrey G. Morgan.*

JENKINSON, E. L. Diverticula of the esophagus. *Radiology*, May, 1930, 14, 508-512.

Diverticula of the esophagus are classified by the author as (1) pulsion, (2) traction and (3) traction-pulsion. The pulsion type may be congenital, be present at an early age; or may develop during late adult life. Symptoms are usually present, and depend upon the amount of food retained in the sac, leading to dilatation of the sac, and pressure. These diverticula are most common at the junction of the pharynx and esophagus. If they are in the lower third of the esophagus, the sac is usually small and points down. They probably occur through a weak spot in the esophagus, possibly where a blood vessel passes through the muscle. Traction type diverticula are most common in the middle third of the esophagus, following some inflammatory pro-

cess in the lungs, pleura, or mediastinum. The adhesions which follow pull the esophagus outward. The sacs are usually small and the apices point upward. They usually cause no symptoms, unless they harbor food and become dilated. They develop into the traction-pulsion type and become large, due to pressure. Multiple diverticula of the esophagus are not common, but do occur. The cases the author has seen have been located in the middle third, and range in size from 5 mm. to 3 cm. They usually cause symptoms and he believes are of the pulsion type.—*J. D. Camp.*

#### ABDOMEN

PODESTA, V. Il quadro radiologico del tubo digerente in un caso di dispepsia nervosa con pneumatosi gastrica e meteorismo cronico del tenue e del crasso intestino. (The roentgen picture of the digestive tract in a case of nervous dyspepsia with pneumatosis of the stomach and chronic meteorism of the small and large intestine.) *Arch. di radiol.*, Sept.-Oct., 1929, 5, 873-890.

A case is described in a woman of thirty-nine whose first child was born when she was thirty-two years of age. During the pregnancy and for about six months after the puerperium she had digestive disturbances consisting of diffuse pain in the abdomen, particularly the epigastrium, eructation and flatulence, nausea, occasionally vomiting and diarrhea; at times bulimia and acoria, generally stubborn constipation. She recovered after she stopped nursing the child but during the second pregnancy the symptoms returned and in addition she had insomnia and marked loss of weight. She was treated at various sanatoria and improved a great deal. But after the death of her husband the symptoms recurred and she had not been free of them since. She was treated at various hospitals and in one of them an appendectomy was performed.

She was sent to the author in October, 1928, for roentgen examination. Wassermann negative. She was very much depressed; the walls of the abdomen were flabby, there was meteorism, no localized pain points. The patient said she had so much digestive disturbance after eating that she ate little but eggs and milk. She complained of dryness of her mouth and throat, eructation, pyrosis, flatulence and intermittent abdominal cramps.

Roentgen examination showed scoliosis of the spinal column but no lesions of the bodies of the vertebrae. There was marked meteorism of both the small and large intestine and a large amount of gas in the stomach. Gall-bladder normal. The stomach on different examinations showed different forms: hour-glass shape, snail-shape, cascade stomach, etc. Emptying time of the stomach and of the small intestine normal. As the author could find no reason for her symptoms, he sent her to a neuropathologist under whose treatment she improved greatly; she gained 14 kilograms in weight and another roentgen examination showed no meteorism and no deformity of the stomach.

He weighs the evidence in the case and concludes that the disturbance was purely nervous. It came on the first two times during pregnancy and the third after the death of her husband. He thinks the meteorism of the intestines could not have caused the various deformities of the stomach. They may have been caused partly by contracture of the stomach, and Assmann says that when there is irritability of the gastric mucosa the pressure exercised by a distended colon may cause active tetanic contraction of the walls of the stomach.—*Audrey G. Morgan.*

MORTON, CHARLES B. Hypertonicity in hypertrophy of the pylorus in adults. *Arch. Surg.*, March, 1930, 20, 508-514.

Attention is called to this syndrome with the belief that it constitutes a definite clinical entity. The author reports 3 personal cases in detail. The literature on the subject is scant but the condition has been recognized as one causing definite gastric symptoms, has been found at operation unassociated with other gastric lesions and has been relieved by repair or gastroenterostomy.

The cause is not known. It seems probable that abnormal nerve stimuli or abnormal response to normal stimuli may cause pylorospasm and that long-continued spasm may cause hypertrophy. The symptoms resemble those of peptic ulcer. Epigastric distress and fullness rather than actual pain, nausea and periodic vomiting are prominent findings.

The final diagnosis must be made roentgenologically. Constant spasm of the pylorus with more or less lengthening and narrowing of the

lumen of the pylorus is presumptive evidence and when accompanied by signs of gastric stasis or retention is conclusive evidence of pyloric stenosis. The stasis is not a constant feature however. It is probable that many such cases have been diagnosed "pylorospasm" and dismissed as neurasthenic cases.

Surgical treatment is indicated in all but the mild cases. Plastic repair and gastroenterostomy have brought permanent relief.—*P. A. Bishop.*

STEINBACH, M. MAXIM. Comparative radiographic and anatomical studies of intestinal tuberculosis. *Am. Rev. Tuberc.*, Jan., 1930, 21, 77-101.

A study is made in which the roentgen findings in the gastrointestinal tract of 67 cases of far-advanced pulmonary tuberculosis are compared with the findings at necropsy.

A review of the literature relative to the roentgenologic diagnosis of intestinal tuberculosis is given starting with the work of Stierlin, reported in 1911. The classical Stierlin sign of cecal tuberculosis is the failure to visualize the cecum and ascending colon, whereas the terminal ileum and the transverse colon are filled, the opaque medium having been given by mouth. Subsequent investigators found that Stierlin's sign was not pathognomonic for tuberculosis.

The work of Brown and Sampson in this country has given a strong impetus to the use of roentgenography in the diagnosis of intestinal tuberculosis. In 2,595 patients that were studied roentgenologically at Trudeau for the presence or absence of intestinal disease, the diagnoses in 35 were verified by surgical exploration and in 21 by autopsy, while in only 2 was there a disagreement between roentgen and pathological findings. This stimulating work prompted the authors of the present paper to adopt the roentgenogram in the diagnosis of intestinal tuberculosis.

Sixty-seven cases studied roentgenologically came to autopsy. These cases were grouped as follows:

Group 1. Cases in which the roentgen findings coincided with autopsy findings (32).

(1) Positive roentgenologically and at autopsy (20).

(2) Suspicious roentgenologically for positive findings and at autopsy positive (5).

(3) Roentgenologically negative and at autopsy negative (7).

Group 2. Cases in which the roentgenologic findings were at variance with autopsy findings (35).

(1) Roentgen picture of intestinal tuberculosis but negative at necropsy for tuberculosis (3).

(2) Roentgen picture normal—at necropsy positive findings of intestinal tuberculosis (18).

(3) Roentgen findings indefinite—positive at necropsy (6).

(4) Roentgen findings indefinite—negative at necropsy (4).

(5) Roentgen findings indicated tuberculous colitis but autopsy revealed the lesions to be located solely in the small intestine (4).

It is seen from this study that the roentgen signs usually considered diagnostic of intestinal tuberculosis were unreliable in over 52 per cent of the cases.

Various writers are quoted to show that the incidence of intestinal tuberculosis in association with fatal pulmonary tuberculosis is rather high, ranging from 56.6 per cent (Fenwick and Dodwell) to 92.6 per cent (Englesmann). In spite of this high incidence it appears to be the general experience of clinicians that in 50 to 75 per cent of cases the diagnosis of intestinal involvement is missed in pulmonary tuberculosis.

The point is emphasized that pathological examination of the intestine should in all cases be microscopical as well as gross. Examination of the intestine without incising the gut is not to be relied upon, since many of the early ulcerations involve only the mucosa and submucosa. It must be obvious, therefore, that surgical inspection of the intestine in vivo will fail to visualize a considerable number of tuberculous ulcerations.

From their experience with the roentgen examination the statement made by the authors that "in view of the difficulty of arriving at a diagnosis, any new method that promises to be of assistance would eagerly be adopted" still holds good.—*Karl Kornblum*.

PODESTA, V. Contributo all studio dei vizi di posizione e di grandezza del cieco e del colon. (Abnormalities in the position and size of the cecum and colon.) *Arch. di radiol.*, Sept.-Oct., 1929, 5, 853-872.

There are many abdominal cases with vague symptoms that are very hard to diagnose. There is pain, more or less localized or diffuse, meteorism, stubborn constipation with periods of mucomembranous diarrhea, gastric disturbances which sometimes suggest organic lesions of the stomach, loss of strength and weight, hypochondriacal nervous symptoms, etc. The author says that roentgen examination of the digestive tract has shown that many of these syndromes are caused by abnormalities in the position, size and length of the large intestine due to arrest of development of the colon at various stages of embryonic life. Such abnormalities cannot be diagnosed in any other way than by roentgen examination.

He describes and gives illustrative roentgenograms of 2 cases which he has seen recently. In the first one, in a woman of forty-seven, there was a partial situs inversus of the abdominal viscera from an arrest of rotation of the colon in embryonic life. The whole of the colon was affected by the dolichomacrocolia, particularly the transverse colon, but the ascending colon and sigmoid were also long. The cecum was on the left and low down in the true pelvis. In the second case, in a man of fifty-one, the cecum was enormously dilated and high up just beneath the liver. The cecum was almost parallel to the transverse colon which was short, while the descending colon was very long. The sigmoid was on the right beneath the cecum and was relatively small and short. There was marked retardation in the emptying time of the stomach and of the enlarged cecum.—*Audrey G. Morgan*.

WEBER, H. M. Factors of error in the roentgenologic diagnosis of diseases of the colon. *Radiology*, May, 1930, 14, 460-466.

The author prefers the opaque enema for examination of the colon. Since fecal material in the bowel may not only make satisfactory study of the colon impossible but also produces defects resembling those of organic disease, he routinely requires the patient to take 2 ounces of castor oil the evening before examination and cleanse the bowel with a soapy enema next morning. His examination is roentgenoscopic and the abdomen is freely palpated to separate superimposed loops of bowel in order that all parts of the colon may be studied. If the patient has undue difficulty in retaining

the enema, or if spasm is marked and perplexing, he administers 60 drops of tincture of belladonna, divided into three equal doses, two of which are given two hours apart in the evening and the remaining dose next morning an hour before re-examination. The filling defect is by far the most common roentgen manifestation of organic disease of the colon, and is produced by cancer, diverticulitis, tuberculosis, chronic ulcerative colitis, extrinsic lesions, organic stricture, and syphilis in about that order of frequency. To distinguish between these diseases the examiner must consider the site and configuration of the defect, the presence or absence of a palpable mass, and the fixation or mobility of the affected portion of the bowel.—*J. D. Camp.*

AUCHINCLOSS, HUGH. A clinical study of calcified nodes in the mesentery. *Ann. Surg.*, March, 1930, 91, 401-415.

As the title indicates, this paper is in the main a clinical study of a symptom-complex that is caused by tuberculous infection of mesenteric lymph glands. Calcified mesenteric nodes represent healed or partially healed foci of infection. Adequate emptying of the colon previous to roentgen study is emphasized, as well as the desirability of making several films, prone, supine and lateral.

These lesions may cause symptoms due: (1) to adhesion bands and contractions; (2) to other intestinal or lymph node lesions of a like nature but still active, not scarred nor calcified, and (3) to the presence of the node alone.

When calcified nodes are found, it is frequently possible to get a history of the actual infection, a period in childhood when the patient was definitely below par, usually underweight, always needing a tonic, never quite cured of anything and always convalescing slowly.

Acute abdominal symptoms and signs, without leucocytosis or increased polymorphonuclear count should always arouse suspicion of tuberculous mesenteric node infection, whether calcified or not, especially if the pulse and temperature are low.—*P. A. Bishop.*

SCHWARTZ, JOSEPH. Suppuration in the subphrenic region, with special reference to primary idiopathic liver and subphrenic

abscess. *Arch. Surg.*, Feb., 1930, 20, 317-332.

Liver and subdiaphragmatic abscesses, in 95 per cent of cases, are said to be due to lesions of the stomach, appendix, biliary tract and duodenum, in the order named. Another type occurs without demonstrable foci and is called the primary or idiopathic type. Eight such cases are reported by the author.

The condition is usually diagnosed late, after it is well established. It is most frequently mistaken for pneumonia or pleurisy with effusion. These thoracic changes are believed to be due to elevation of the diaphragm with resulting compression of the lung and promptly disappear after the abscess is drained.

Roentgenograms and fluoroscopy are important aids in diagnosis. It is strongly urged that these examinations be repeated frequently whenever such a lesion is believed to be developing. The roentgen features are: (a) an elevation of the diaphragm with restricted excursion; (b) the presence of air, with or without a fluid level, beneath the diaphragm, and (c) intrathoracic changes leading to a diagnosis of pneumonia and pleural effusion.

The mortality rate is high because of late or non-recognition and its association with other extensive lesions.—*P. A. Bishop.*

#### SKELETAL SYSTEM

LOCKWOOD, I. H., JOHNSON, E. T., and NARR, F. C. Hodgkin's disease with involvement of bone and skeletal muscles. *Radiology*, May, 1930, 14, 445-452.

The authors present a case of Hodgkin's disease in a boy aged fifteen, whose first symptom was shingles and whose chief complaint on admission was backache. At this time a roentgenogram revealed definite bone destruction in the first four lumbar vertebrae, the ilium and the femurs, although six months previously no definite changes in these structures were demonstrable. Biopsy established the diagnosis of Hodgkin's disease. The course was one of increasing severity with bone destruction of the dorsal and lumbar vertebrae, ilium and femurs, and involvement of all lymph nodes, lungs, liver and skeletal muscles. The writers think that shingles has too frequently been reported in Hodgkin's disease to be without significance.—*J. D. Camp.*



BÁRSONY, THEODOR, and KOPPENSTEIN, ERNST. Calcinosi intervertebralis. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Feb., 1930, 41, 211-239.

The author presents 8 cases of intervertebral calcifications of his own and 9 cases collected from the literature. On the basis of a study of these cases the following conclusions are drawn: Intervertebral calcifications may involve part or the entire nucleus pulposus and may extend to the annulus fibrosus. According to the site and extent of the calcification a very manifold roentgen appearance is obtained. The incidence of the roentgen rays as well as the position of the patient may lead to further distortions, the incidence of the rays influencing even the homogeneity of the calcium shadows. Thus the more eccentric the direction of the central ray, the less homogeneous the roentgen image of the calcified area.

The author observed that when the calcification extended from the nucleus pulposus to the annulus fibrosus a small peripheral zone always remained free of calcium deposit. This zone he called the calcium resistant zone, while the central zone was named the zone of calcium affinity. In many instances there was evidence of calcium deposits also on the edge of the intervertebral discs. This he called the peripheral zone of calcium affinity.

Central calcifications were observed between the fifth dorsal and first lumbar segments, while the peripheral calcifications occurred on the entire spine.

The central calcifications of the intervertebral discs do not form a typical clinical picture. Sometimes no symptoms whatever are present and at other times the symptomatology is very severe (pain, lumbago, rheumatism, etc.). The therapy is symptomatic and is the same as for any spondylosis.—*T. Leucutia*.

FRIEDRICH, H. Über Lymphogranulomatose (Hodgkin) des Knochens. (On lymphogranulomatosis (Hodgkin) of bones.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Feb., 1930, 41, 206-211.

The extension of Hodgkin's disease to the bony structures is very rare. The few cases recorded in the literature are briefly reviewed.

The author describes in detail a case, that

of a boy aged twenty, in which the Hodgkin's disease had extended to both lower jaws. The roentgenograms presented an irregular thickening with numerous areas of rarefaction in the central and with a rather marked increase in the density in the marginal portions of the bone. The appearance was very similar to that of osteitis fibrosa (Paget).

The application of roentgen therapy produced a local healing. Two years later the patient died from a general extension of the disease.—*T. Leucutia*.

KIENBÖCK, R. Über die sogenannte "ostitis fibrosa" ("Osteodystrophia fibrosa"). (On the so-called "osteitis fibrosa"—"osteodystrophia fibrosa".) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1930, 41, 34-38.

1. Osteitis deformans (Paget's disease). This consists in an atrophic-hypertrophic dysplasia of the bony structures, roentgenologically characterized by increased density of the bones of the skeleton.

2. Osteitis fibrosa cystica generalisata (Recklinghausen). This condition is characterized by atrophic dysplasia alone and is localized to parts of the skeleton or the entire skeleton. Roentgenologically it appears in the form of areas of rarefaction.

There is a great dissension with regard to the etiology of these two conditions. The dualists believe that osteitis deformans (Paget) and osteitis fibrosa cystica generalisata (Recklinghausen) are two distinct entities, while the unitarians are of the opinion that they are manifestations of one and the same disease.

The author, on the basis of a study of a large number of cases, favors the dualistic theory, and in the near future will present a series of articles in support of this theory.—*T. Leucutia*.

WEISS, KONRAD. Die Osteoporosis circumscripta Schüller—eine seltene, aber typische Erscheinungsform der Pagetschen Knochen-erkrankung. (Osteoporosis circumscripta (Schüller)—a rare but typical form of Paget's disease.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1929, 41, 8-16.

Schüller in 1929 described a form of osteoporosis of the skull, the so-called "osteoporosis circumscripta," which was characterized by areas of rarefaction of both tables of the skull without evidence of alterations in the rest of the skeleton. Schüller assumed that the

condition was a distinct entity although he admitted that a similarity with Paget's disease existed.

The author was able to observe osteoporosis circumscripta of the skull in 2 cases (a man sixty-six years of age and a woman of forty-eight), in which in addition to the changes in the skull there was evidence of typical Paget's disease of several bones of the skeleton. From this he deduced that the osteoporosis circumscripta as described by Schüller does not constitute a separate entity but that it is merely a manifestation of Paget's disease.—*T. Leucutia*.

MADLENER, M. J., and PAAS, H. R. Über röntgenologisch feststellbare Deformierungen der Kniescheibe nach Patellarfrakturen. (On the roentgenologically demonstrated deformities of the knee cap following fractures of the patella.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1930, 41, 38-43.

Sixty-four cases of patellar fractures were observed between 1919 and 1928, of which 31 were followed up. The control examinations consisted in the taking of roentgenograms in the lateral, posteroanterior and axial direction.

It was found that the late deformities of healed patellar fractures (whether they were treated conservatively or by wire suturing) consisted: (1) in elongation of the patella in the sagittal axis due to pull of the muscles during the actual duration of the callus formation; (2) in a slight increase of the transverse diameter of the patella; (3) in a roughening of the anterior and posterior surfaces of the patella, and (4) in a deposit of calcium in the soft structures around the patella (quadriceps tendon, ligamentum patellae, etc.).

The author calls attention to the fact that the roentgen examination in the axial direction is of great aid in diagnosing imperfectly healed longitudinal fractures of the patella.—*T. Leucutia*.

JUNGHANNS, HERBERT. Die Spondylolisthese im Röntgenbild. (The roentgen picture of spondylolisthesis.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Feb., 1930, 41, 239-245.

On the basis of a study of the anatomical specimens of 30 cases, the author expresses the opinion that spondylolisthesis is the result

of a congenital anomaly of the articulation between the fourth and fifth lumbar vertebrae. This anomaly consists in a slight gaping of the intervertebral processes which later due to repeated trauma and because of the lessened resistance gradually increases, leading to a slipping of the body of the fourth lumbar vertebra over that of the fifth. During this process the articular and spinous processes maintain their normal position. The slipping of the body of the fourth lumbar vertebra leads to a number of secondary changes such as narrowing of the intervertebral space, S-shaped deformity of the intervertebral disc, thickening of the adjacent portions of the vertebral bodies, formation of osteophytic deposits and increase of the lumbosacral angulation.—*T. Leucutia*.

## ROENTGEN AND RADIUM THERAPY

ADLER, KARL. Die Beeinflussung des Gewebstoffwechsels durch Röntgen- und Radiumbestrahlung. (Effect of roentgen and radium radiation on tissue metabolism.) *Strahlentherapie*, 1929, 34, 587-588.

In these experiments oxidation and lactic acid formation under aerobic and anaerobic conditions were determined. A series of sexually mature rats were given an irradiation of 600 R on the testicles and metabolism determined, after having found the normal values on unirradiated rats. There was no change in cell metabolism immediately after the irradiation. So the rays do not act primarily on cell metabolism. The first changes began twenty-four hours after irradiation and increased with time. Tissue respiration decreased and aerobic and anaerobic glycolysis rose to double their normal value. The highest values were reached on the 34th to 36th day after the irradiation. This approximates the type of metabolism of malignant tumors. After the 40th day the figures for glycolysis fell to below normal. Histological examination showed degenerative changes in the nuclei of the semen-producing cells. After the 40th day the degenerated cells were cast off and the lumina of the tubules of the testicles were partially filled with proliferated Sertoli cells. About this time aerobic glycolysis fell almost to zero and anaerobic glycolysis to less than the normal value for the non-irradiated testicle.

A second series of animals were irradiated with 2500 R. The changes in metabolism were the same in nature but took place more rapidly. A third series were irradiated with 2400 mg-hr. of radium. The changes were the same except that respiration decreased even more rapidly and intensely and glycolysis did not reach the same height as after roentgen irradiation. Serum was also irradiated and showed the same changes in metabolism. These changes in metabolism approximating the type of metabolism of malignant tumors explain why carcinoma may develop after chronic injury with small doses of roentgen and radium rays.—*Audrey G. Morgan.*

FREUND, L. Studien über den Ablauf von Radiumreaktionen auf der gesunden und kranken menschlichen Haut. (The course of radium reactions on the normal and diseased human skin.) *Strahlentherapie*, 1929, 34, 767-786.

The experiments were made with capsule-shaped radium carriers in which 60.4 mg. radium-barium sulphate was distributed over a round surface with an area of 3.1 sq. cm. The layer of radium was covered with a mica window 0.1 mm. thick and that with a silver window 0.2 mm. thick, made as nearly gas-tight as possible. The radium content was 17.75 mg. Curves and tables are given showing the details of the results.

When an erythema dose was applied for forty minutes there was a preliminary wave of redness beginning after a short latent period and rising to about the 5th degree of redness and then falling rapidly. From the 14th day it began to rise to the chief reaction which reached its maximum on the 57th day which was considerably higher than that of the preliminary reaction (10th degree of redness). It quickly fell from this peak and reached its lowest point (1st degree of redness) on the 72d day, then rose a little and gradually disappeared. Between the preliminary and chief reactions there was a third wave. There are differences in different individuals with regard to the beginning of the rise, the length of the waves, the time at which they reach their maximum and the height of the maximum. There are such differences not only in different individuals but in the same individual at different times and on different parts of the body.

When the forty minute dose was divided into four ten minute doses the curve was more complicated; it may be said roughly to correspond to four curves like that described above.

The radium was then applied to cases of psoriasis to try to determine the relation between the erythema and the therapeutic effect. The therapeutic effect was found to be proportional to the erythema but there was no relation between the pigmentation curve and the course of the disease.—*Audrey G. Morgan.*

MAY, E. A. Roentgen therapy in acute inflammatory conditions. *Radiology*, April, 1930, 14, 411-415.

Roentgen treatment of acute inflammatory conditions is of great help to surgery and also to more conservative methods, in the opinion of the author. It cannot replace old methods but is a very helpful adjunct to them. It not only alleviates pain, but also affects the entire process of inflammation. It should not be undertaken without proper surgical supervision. Its beneficial action is both local and general. The local effects are hyperemia, dilatation of the blood vessels, increased circulation of the lymph, and other local immunizing processes. In general, it tends to increase the specific and non-specific forces of resistance. The optional dose of radiation lies between 130 and 300 r-units on the skin over the inflamed area, using heavy filtration and high voltage. Two hundred thirty-five cases, comprising furuncle, osteomyelitis, paronychia, pneumonia, and various other acute inflammations, were subjected to roentgen treatment by May, and benefit resulted in 81.3 per cent.—*J. D. Camp.*

TAMIYA, CH., and Koyama, M. Über röntgenologische Behandlung der Verbrennung und Verätzung der menschlichen Haut. (Roentgen treatment of burns and cauterization of the human skin.) *Strahlentherapie*, 1929, 34, 808-812.

The authors treated 13 cases of burns and 2 of cauterization with roentgen rays. The burns were mostly of the first and second degree, one of the first degree. Most of the cases were sent after other methods had failed. Before the irradiations the salves that had been used were washed away, the area cleaned and disinfected with alcohol or sublimate. The torn skin was drawn over the exposed corium. It was not necessary to open even large vesicles, as is

done generally; they were left untouched or at most punctured aseptically to let out excessive contents. It is important not to remove them and expose the corium. The dose was 1 to 3 H (about 12 to 36 per cent of a skin erythema dose), filtered through 1 mm. Al, with 4.5 ma. and 80 kv. With a focus-skin distance of 30 cm. the desired dose was given in one minute eighteen seconds to three minutes fifty-four seconds. The burned places were covered with aseptic cotton fastened on with gauze and adhesive plaster.

The results were excellent. There was rapid decrease of the pain which began a few hours or sometimes immediately after the irradiation. There was rapid decrease of the redness and swelling and drying of the exposed corium and rapid absorption of the contents of the vesicles. Invasion of bacteria was prevented by rapid cornification of the exposed layer of corium. The method itself has the advantage that it is not necessary to remove the vesicles or change dressings often. The method will probably shorten the time required for the healing of burns.—*Audrey G. Morgan.*

EWING, JAMES. Factors determining radioresistance in tumors. *Radiology*, March, 1930, 14, 186-190.

The author holds that the resistance of tumors to irradiation may be due to the adult character of the stroma; this form of resistance is observed in many types of sarcoma of bone, nerve and cartilage. The adult characters of epithelial cells and the substantial blood supply render adenomas and papillomas radioresistant. Carcinomas are resistant in inverse ratio to the degree of anaplasia and in direct proportion to the amount of desmoplastic reaction which they excite. In mixed tumors in which one element is sensitive and the other resistant, the malignant portion may be sterilized, although the tumor does not diminish in size and a false impression of radioresistance may be gained; this is exemplified in mixed tumors of the testis and teratomatous tumors in the abdomen, kidney or sacral region. A special instance of spurious resistance is seen in very vascular giant cell tumors, which are well designated as benign bone aneurysms. The nature of the tumor bed in favoring or retarding response to treatment; the high resistance of malignant tumors invading bone or

cartilage is well known. Infected tumors which are the seat of exudative inflammation do not react well to treatment, but a full explanation of this fact is hard to find.—*J. D. Camp.*

HIRSCH, HENRI. Über echte Organotherapie mittels der Hipocide, insbesondere zur therapeutischen Beeinflussung der Carcinom-Kachexie. (Organotherapy with hipocids, particularly in carcinoma cachexia.) *Strahlentherapie*, 1929, 34, 381-402.

In attempts to increase the action of roentgen rays the author used iodized wax (dextrocid). He decided that this preparation which was so good for sensitizing purposes could also be used for organotherapy if it could be combined with organ extracts. He succeeded in storing the organ extracts in the dextrocid by a method of dialysis and called these preparations hipocids. He made them with extracts of various organs. They can be kept indefinitely because the iodine sterilizes them. He first tested the liver hipocid in Biermer's anemia and found that it brought about great improvement in the blood picture. He then used it in various pregnancy toxicoses supposed to be due to insufficiency of the liver with equally good effect. As disturbed liver metabolism seems to be the cause of cancer cachexia he also used liver hipocid on this condition; later he prepared a triple hipocid of liver, pancreas and spleen and used it in cancer cachexia. At first to increase calcium metabolism he used an extract of parathyroid but later substituted administration of calcium for this. Calcium changes the acid medium in which cancer seems to thrive best in the direction of alkalinization. He gave roentgen dextrocid treatment and between the series of irradiations hipocid treatment by mouth. He greatly improved his results in the treatment of malignant tumors in this way. His material was the worst possible as the patients were in an advanced stage of cachexia with recurrences and metastases. He has now treated 63 cases with hipocid from 1926 to 1928. After roentgen-dextrocid treatment and within four to seven months after the beginning of hipocid treatment and generally within fifty to sixty days, the hemoglobin content of the blood rose at least 15 per cent, the erythrocytes increased on an average of 1.3 million and the leucocytes by about 5600. The weight curve



rose with the improvement in the general condition and blood picture. A gain of 10 pounds in a short time was not unusual. From the middle of 1926 to the middle of 1927, 20 cases of carcinoma were treated. All had been operated on and were sent for treatment for recurrence or metastasis. Seven of these patients died in the course of 1928; the other 13 are alive and continuing to improve. From the middle of 1927 to the middle of 1928, 43 cases were treated; 14 of these patients have died, the others are alive. Among the total of 63 cases 21 patients have died; 42 were living in June, 1929. Of course definite judgment cannot be passed on the cases until after five years but the condition of the patients is such that it justifies extensive use of the method.—*Audrey G. Morgan.*

SEULBERGER, P., SCHMIDT, W., and KRÖNING, F. Röntgenologische Untersuchungen an Carcinomen. I. Cytologie und Histologie der Tumoren nach mehrfacher Bestrahlung. (Roentgen studies of carcinoma. I. Cytology and histology after several irradiations.) *Strahlentherapie*, 1929, 34, 247-272.

In a former article the authors reported the appearance of the mitoses and chromosomes in human tumors before and after irradiation with a single large dose of roentgen rays. In this article they report the results after single and multiple irradiations with small doses. They describe the details in regard to normal mitoses, injured mitoses, pycnoses, autolysis, cornification, edema, hyperemia, round cells, leucocytes and lymphocytes, between the tumor cells, and the mobilization and proliferation of undifferentiated young connective tissue in 6 cases. In 2 cases 20 and 50 per cent of a skin erythema dose was given once. In the third case  $33\frac{1}{3}$  per cent was given and after five days 50 per cent. In the fourth case  $33\frac{1}{3}$  per cent was given 4 times with intervals between the doses of 3, 4 and 9 days. In the 5th case  $33\frac{1}{3}$  per cent was given 5 times, with intervals of 3, 10, 11, 5 and 11 days. In the 6th case two series of irradiations were given. In the first series  $33\frac{1}{3}$  per cent was given five times with intervals of 2, 2, 3 and 4 days and in the second series  $33\frac{1}{3}$  per cent was given four times with intervals of 4, 10 and 7 days, then after 9 days 50 per cent and after 13 more days 60 per cent. Sometimes by regulating

the dosage by the appearance of the mitoses with the histological picture of the tumor results can be attained with 20 to 50 per cent of a skin erythema dose as good as are ordinarily attained by 80-100 per cent. The reaction of the mitoses is of course much more sensitive than the clinical reaction. The dose and rhythm of the irradiation are not yet well enough worked out so that deep carcinomas can always be cured, but the method is hopeful.—*Audrey G. Morgan.*

RODENBAUGH, FREDERICK HASE. Treatment of malignant tumors of the eye and orbit by radiation. *Radiology*, March, 1930, 14, 309-315.

The present status of radiation therapy for tumors of the orbit is summarized by the author as follows: In tumors of the conjunctiva and cornea, radiation, preferably from radium, with a maximum conservation of normal tissue looking to clinical cure, should be given first consideration. In basal cell epitheliomas of the adnexa, as elsewhere in the body, the clinical cures are satisfactory and radiation is superior to other methods of treatment. The angiomas, lymphomas, sarcomas, granulomas, fibromas, and nevi, occurring as primary tumors, are susceptible to radiation, their response varying with their histological structure. The numerous metastatic tumors will vary in their response to radiation, their susceptibility depending on their histological structure. Types of localized tumors of the iris or ciliary body, of doubtful nature, have been favorably influenced by radiation, and such treatment should receive consideration before resorting to radical surgical methods. It is of greater importance to secure clinical regression of a new-growth, with conservation of essential structures, than to have a histological study with loss of function.—*J. D. Camp.*

QUICK, DOUGLAS. Treatment of malignant growths of the nasal accessory sinuses and nasopharynx. *Radiology*, March, 1930, 14, 191-196.

The author states that radium and roentgen rays are of value in treating this group of cases, but, except in palliative procedures, must be used in conjunction with surgery. Radium and roentgen rays may be depended on to eradicate the tumor tissue if applied ac-

curately and uniformly throughout the growth in sufficient dosage. Surgery must be employed to provide exposure for radium application and adequate drainage. The anatomical relations are such that infection is a much greater menace here than in new-growths in most other locations.—*J. D. Camp.*

SCHULTE, G. Ein seit 6 Jahren nur durch Röntgenbestrahlungen geheiltes Zungencarcinom. (A case of carcinoma of the tongue cured for six years by roentgen treatment alone.) *Strahlentherapie*, 1929, 34, 541-543.

This case is reported because there has not been such long freedom from recurrence (more than five years) in any other case of carcinoma of the tongue treated with roentgen rays alone. The patient was a man of fifty-two who came for treatment in February, 1923, with a carcinoma of the whole base of the tongue extending to the pharynx and glosso-epiglottidean ligament and far forward. There was little hope from operation as there were gland metastases. Irradiation was given with Jüngling's radioplastin method. The whole of the mouth and gland region are irradiated homogeneously on three successive days with 100 per cent of the carcinoma dose, the larynx and salivary glands being protected as far as possible. There was an intense primary reaction. For a time the patient had dyspnea and could not swallow. Ten days after the irra-

diation improvement began. A piece of the tumor was cast off; it showed carcinoma cells and in places necrosis and leucocyte infiltration. Four weeks after the irradiation the tumor had disappeared and the patient was free of symptoms. There was complete epilation except for a small part over the larynx that had been covered and the patient's mouth was dry. Five months later the patient came back with a tumor the size of a small hen's egg over the left sternoclavicular joint, firmly adherent to the underlying tissues. On both sides of the neck along the sternocleidomastoid there was a chain of glands the size of hazelnuts to the size of dove's eggs. General condition poor. The tumor was extirpated as far as possible under general anesthesia. Microscopic examination showed carcinoma. The field of operation and the glands of the neck were irradiated as before with a full carcinoma dose. Two months later the glands had disappeared. A year later another irradiation of the left sternoclavicular joint was given as it was slightly swollen. Since then the patient has been absolutely well and able to work. The dryness of the mouth persisted for about a year and then gradually disappeared. His beard also grew again gradually. There is a scar on the left border of the tongue but it interferes very little with the movements of the tongue. His speech is clear and there are no swollen glands.—*Audrey G. Morgan.*



# THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. XXIV

SEPTEMBER, 1930

No. 3

## MEDIASTINAL PLEURAL EFFUSION

### A ROENTGENOLOGIC STUDY\*

By JACOB SAGEL, M.D., and LEO G. RIGLER, M.D.

MINNEAPOLIS, MINNESOTA

**M**EDIASTINAL pleural effusion is of rather infrequent occurrence and is often overlooked due to difficulty in diagnosis. It is usually encapsulated but may rarely, like a free pleural effusion, communicate with the general pleural cavity laterally. It is situated in that part of the pleural cavity which is in relation to the mediastinum. It may be combined with diaphragmatic pleurisy or pericardial effusion.

Anatomically, the mediastinal pleural cavity on each side is divided into two parts, an anterior and a posterior (Fig. 1). The anterior space is bounded by the ribs and sternum anteriorly, the hilus posteriorly, the mediastinal part of the lung laterally, and the heart and mediastinum medially. The posterior space is bounded by the hilus anteriorly, by the ribs posteriorly, by the spine and mediastinum medially, and by the mediastinal part of

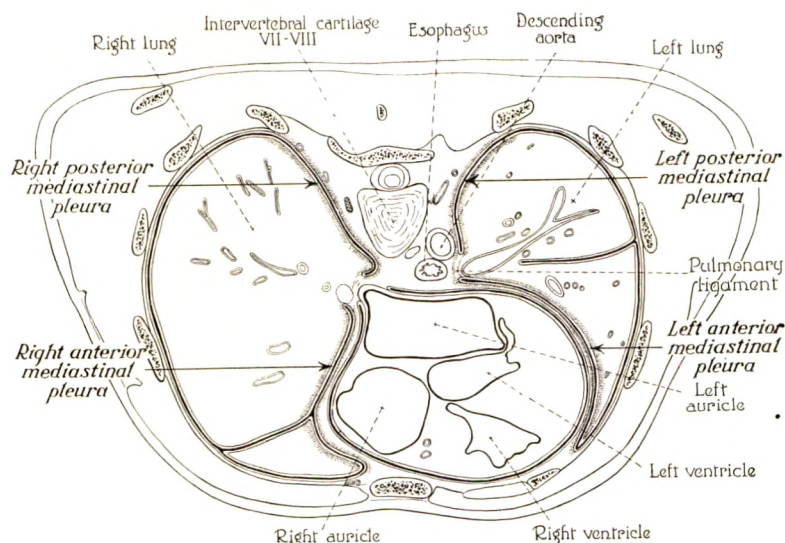


FIG. 1. Cross-section of thorax. The pleural spaces are represented in black. The mediastinal pleural space is stippled and the four divisions are shown. Note the pulmonary ligament which separates the anterior from the posterior mediastinal pleura on both sides.

\* From the Departments of Roentgenology of the University of Minnesota, the University Hospital, and the Minneapolis General Hospital, Minneapolis, Minn.



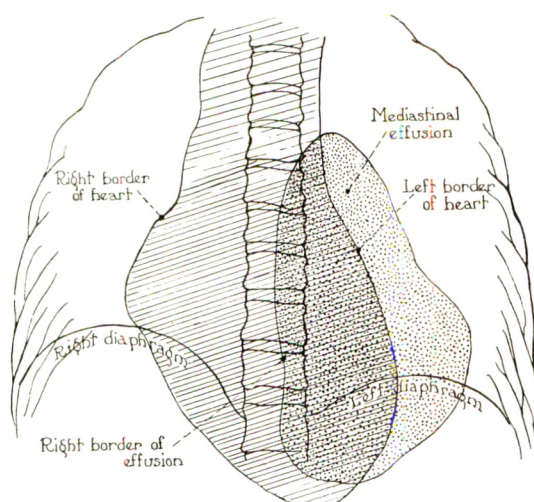


FIG. 2. Diagram of anteroposterior roentgenogram of Case 1. The triangular shadow representing the left posterior mediastinal effusion is shown overlapping the heart shadow which is displaced to the right. Note the increased density of the area in which overlapping is present.

the lung laterally. These two parts of the mediastinal pleural cavity are separated from each other chiefly by the pulmonary ligament, and communicate with each other only above the level of the hilus of the lung. The mediastinal pleural cavity also communicates at the hilus level with the interlobar fissures. Barjon<sup>2</sup> calls this point the "carrefour hilaire," and in some of his cases found the effusion entering these fissures, thus producing in the roentgenogram a round or bean-shaped shadow beside the heart at the level of the hilus.

Considering location, there are four possible kinds of mediastinal pleural effusion: (1) in the anterior space on one side; (2) in the posterior space on one side; (3) the bilateral type, and (4) the so-called "saddle type." In the latter the effusion occurs in both the anterior and posterior spaces by bridging the hilus. Such a case is described by Pel,<sup>9</sup> pus being obtained in both anterior and posterior aspirations, the findings being confirmed at autopsy. Some authors give a slightly different classification. Friek<sup>8</sup> names the following forms: (a) pleuritis mediastinalis anterior dextra; (b)

pleuritis mediastinalis anterior sinistra; (c) pleuritis mediastinalis posterior. He makes this distinction because the characteristic symptoms seem to vary according to the part of the mediastinal pleura involved. Chauffard<sup>5</sup> speaks of two types of mediastinal pleurisy, the "pleurésie en bande verticale" and the "pleurésie en equerre." The former appears on the films as a dense linear shadow anterior and parallel to the spine. This is situated far back in the posterior mediastinal pleural cavity and does not spread out over the diaphragm secondarily. In the second type (Fig. 4), which has also been called the costodiaphragmatic type, the effusion is situated more anteriorly and when its upper border reaches the hilus of the lung, it spreads out and assumes the characteristic right-angled shape. Thus, its shape is determined by its anatomical position.

Etiologically, there are two chief types: (1) the serous type, which is generally associated with pulmonary tuberculosis, and

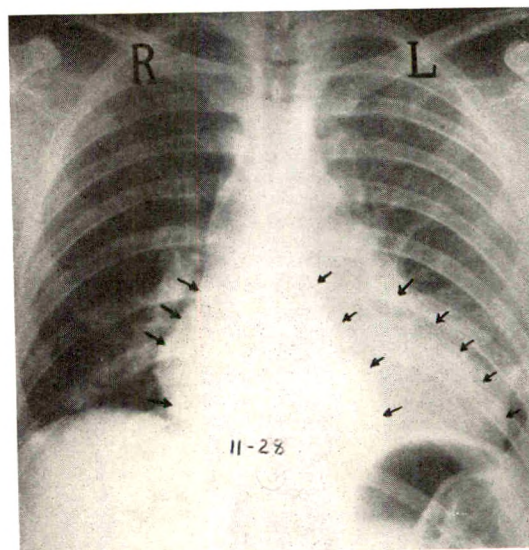


FIG. 3. Roentgenogram of Case 1 showing left posterior mediastinal empyema with displacement of heart to right. Inner row of arrows on left side shows left heart border and outer row of arrows shows lateral border of the empyema. Note increased density where empyema overlaps cardiac shadow. Pus was obtained on posterior thoracentesis on the left side.



(2) the purulent type, which is usually pneumococcic or, rarely, streptococcic in origin. Wessler and Jaches<sup>14</sup> explain the first type by assuming a tuberculous involvement of the mediastinal surface of the lung. The second type is generally secondary to a pneumonia in an adjacent part of the lung. Both of these may terminate as a dry pleurisy which can be readily recognized in the roentgenogram (Fig. 5). Rehberg<sup>11</sup> uses this classification.

There are five points of invasion: from the lung in the presence of pneumonia or tuberculous foci; from the tracheobronchial nodes, which are an important source in children; from the pericardium when an inflammatory process is present, made possible by its very extensive lymphatic network; from the mediastinum and chest wall. The latter includes direct extension

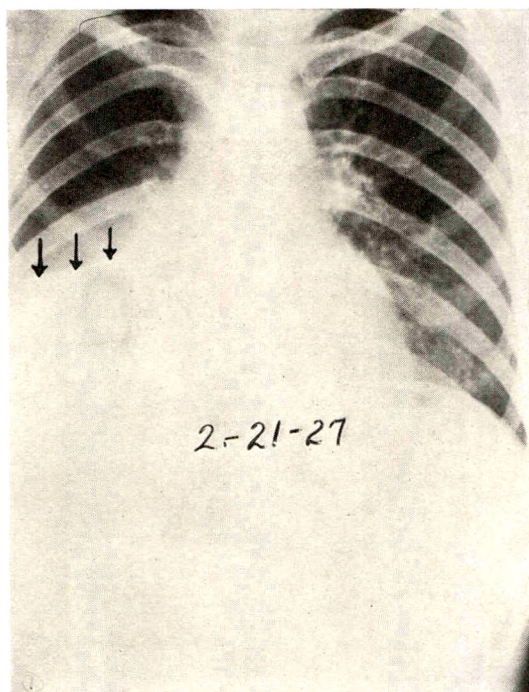


FIG. 4. Roentgenogram of Case II taken soon after admission. The right-sided mediastinal empyema assumes a right-angled shape representing the costodiaphragmatic type. Arrows indicate the upper border of the encapsulation. The lower border is spread out over the diaphragm. Note the origin of the fluid from the mediastinal pleura.

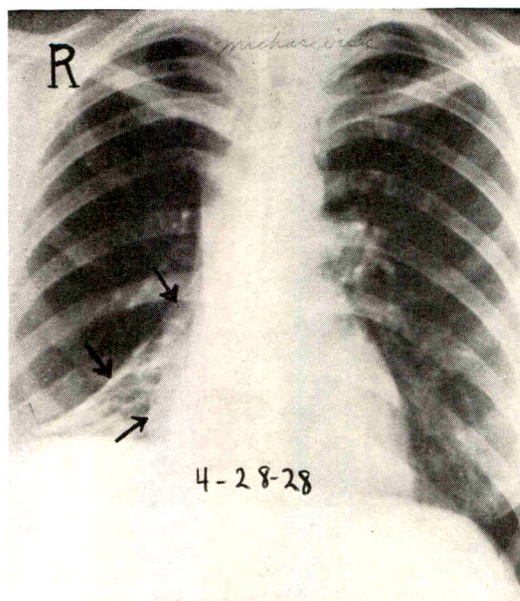


FIG. 5. Roentgenogram of Case II taken fourteen months after Figure 4. Outer row of arrows indicates lateral border of thickened pleura representing the residue of the mediastinal empyema. Inner arrow shows right heart border. This is now a dry pleurisy and shows no change from film taken two months previously.

from inflammations and tumors of the chest wall, paravertebral abscesses and other miscellaneous rare conditions.

The difficulty of diagnosis by physical examination explains why many cases have not been recognized clinically and were discovered only at autopsy. The physical signs are similar to those in encapsulated effusions elsewhere but are difficult to elicit. They are confusing due to the proximity of the heart and mediastinum to which the encapsulation is closely related. The symptoms are quite similar to those of any infectious disease such as pneumonia with which mediastinal empyema is often associated. In addition, there are symptoms due to pressure on structures in the mediastinum in both the anterior and posterior types of mediastinal pleural effusion. In posterior mediastinal empyema there is a well-known symptom-complex which Dieulafoy<sup>7</sup> has called the "syndrome mediastinale." This consists of dysphagia due to pressure on the



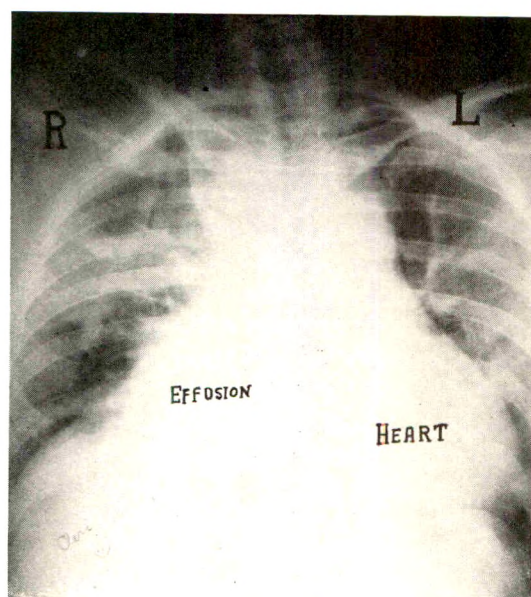


FIG. 6. Roentgenogram of Case III taken with patient supine. Shows a massive right-sided posterior mediastinal empyema. The heart and mediastinum are markedly displaced to the left. Note the appearance of the "double heart" and simulation of a pericardial effusion; 175 c.c. of pus was obtained on posterior thoracentesis.

esophagus, hoarseness due to pressure on the recurrent laryngeal nerve, engorgement of the intercostal veins with the formation of a collateral circulation due to pressure on the azygos vein and paroxysmal cough due to pressure on the vagus nerve. In the right anterior type, cyanosis, limited to the head, neck, thorax and upper extremities, is often a striking feature.

In the anterior type, the differential diagnosis is from exudative pericarditis, anterior suppurative mediastinitis and a free pleural effusion extending into the mediastinal pleura. In the posterior type, the differential diagnosis is from an effusion in the anatomical posterior mediastinal space and from hypertrophied glands, aneurysm, gumma and neoplasms in this region. In discussing the first differential condition, i.e., effusion in the anatomical posterior mediastinal space, Tice<sup>12</sup> points out that this is possible from an anatomical point of view but is very unlikely. Para-

vertebral abscess may also be confused with this condition, but examination in the prone and lateral positions will show that the shadow is definitely separated from the posterior mediastinal pleural space and has its origin in the posterior chest wall. Also, the shadow of a paravertebral abscess is almost always seen on both sides of the thoracic spine whereas posterior mediastinal pleural effusion is always unilateral. Concomitant changes in the spine associated with paravertebral abscess can usually be demonstrated.

Although this paper is not concerned with treatment, a word on that subject may not be out of order. In the serous type it is not necessary to remove the fluid since it is generally resorbed the same as serous fluid elsewhere in the pleural cavity. Thoracentesis is done only for diagnostic purposes. In empyemata early removal is necessary by aspiration or rib resection with open or closed drainage as indicated. This is essential because of the proximity to

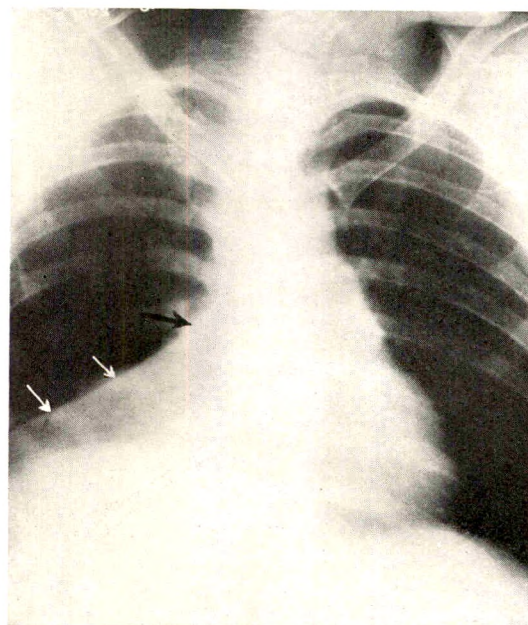


FIG. 7. Roentgenogram of Case IV showing the characteristic triangular shadow on the right of the median shadow extending from the hilus to the diaphragm. Arrows indicate the lateral border of the encapsulation.



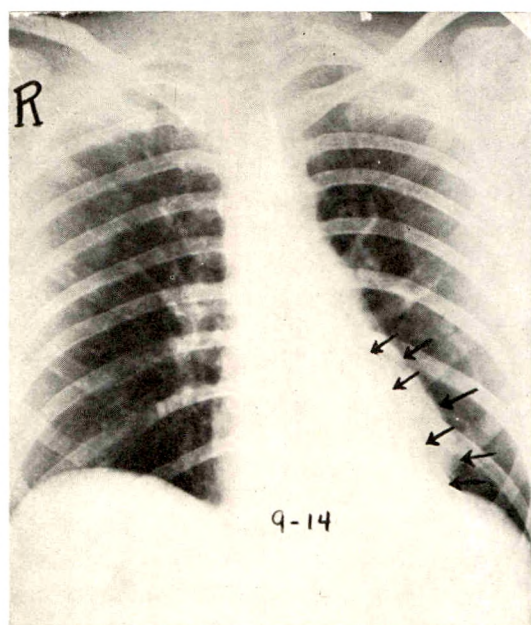


FIG. 8. Roentgenogram of Case v taken in the anteroposterior position. A double shadow is seen to the left of the median shadow. The inner row of arrows marks the lateral border of the mediastinal pleural effusion. The outer row of arrows marks the lateral heart border. Note the characteristic triangular shape of the encapsulation.

important mediastinal viscera. Our experience, which has been chiefly with the posterior type of mediastinal pleural effusion, indicates that the prognosis in this type is generally good, whereas the prognosis in the anterior type is not so favorable.

#### ROENTGEN DIAGNOSIS

As to the technique of examination, both roentgenoscopic and roentgenographic methods are used. Under the roentgenoscope, the patient is placed in various positions to determine whether the triangular shadow produced by the effusion can be separated from the median (cardiac) shadow. This is very important in the differential diagnosis since a failure to separate this abnormal shadow from the median shadow would point strongly to its origin in the mediastinal pleura. This triangular shadow may be situated on either the right (Fig. 7) or left (Figs. 2 and 3) side

of the cardiac shadow and shows no pulsation. A pulsation can be seen on the normal side of the heart but not on the side of the effusion. This point is important in the differential diagnosis from pericardial effusion in which the cardiac pulsation is often transmitted. The shadow of the effusion cannot be separated from the cardiac shadow regardless of the position in which the patient is placed. According to Barjon,<sup>3</sup> it is superadded to the median shadow and deforms and increases it at a point differing according to its location. The adjacent part of the lung or the heart, usually the latter, is often displaced to the opposite side (Figs. 2, 3, and 6). The displacement of thoracic viscera by encapsulated pleural effusions has been noted by Wessler<sup>13</sup> who points out that the displacement depends not only on the size of the effusion but also on its location. A small encapsulation, either basal or mediastinal, may displace the heart because of the direct pressure due to its proximity. On

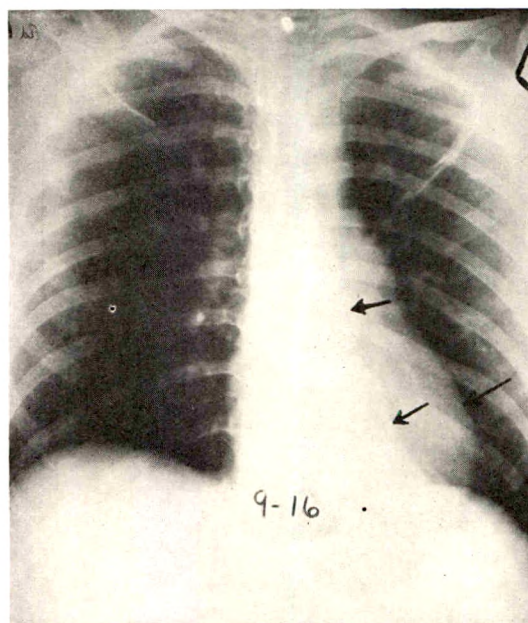


FIG. 9. Roentgenogram of Case v taken two days after Figure 8. Shows a spontaneous decrease in the size of the left-sided mediastinal pleural effusion. Arrows indicate the lateral border of the encapsulation. Compare with Figure 8.



the other hand, a free pleural effusion in the lateral pleural cavity may cause no displacement of the heart and mediastinum until it has obtained a moderate or large

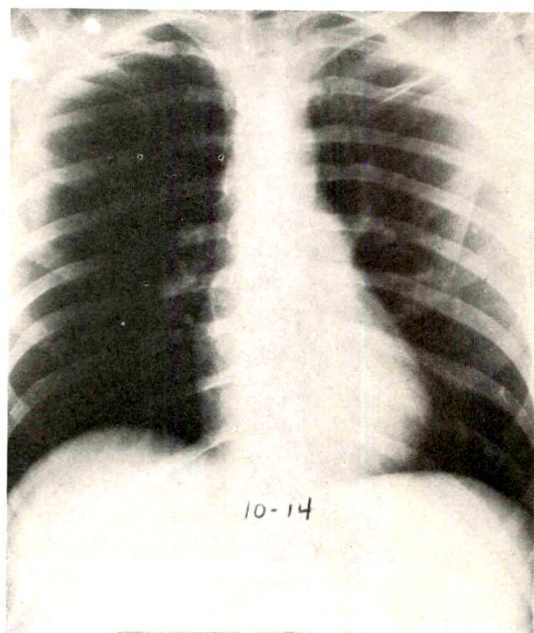


FIG. 10. Roentgenogram of Case v taken one month after onset. Note the absence of the double shadow on the left due to spontaneous absorption of the effusion. Now has the appearance of a normal chest. Compare with Figures 8 and 9.

size. In an anterior mediastinal pleural effusion the heart is displaced only to the opposite side and is not removed from the proximity of the anterior chest wall by the interposition of an exudate as occurs with pericardial effusion. These changes in position are clearly demonstrated on the roentgenogram (Fig. 2).

The roentgenographic findings in mediastinal pleural effusion are fairly typical and have been well described by Devic and Savy<sup>6</sup> in a series of articles. They state that the anterior mediastinal, which in their experience is the most common type, simulates pericarditis with effusion and for this reason has been referred to as "pericarditis externa" and "pseudo-pericarditis." Posterior mediastinal pleural effusion shows linear shadows anterior and parallel

to the vertebral column. This can usually be well demonstrated by films taken in the lateral, oblique and prone positions. The other findings are quite similar to those of the anterior type. Routinely, films are taken in the posteroanterior, anteroposterior, lateral and oblique positions. The most favorable position for roentgenography will be demonstrated by the roentgenoscopic examination. Small posterior effusions on the left side may be readily overlooked in the usual posteroanterior roentgenogram of the chest because of their distance from the film. The anteroposterior film will demonstrate the shadow of the effusion in spite of the superimposition of the cardiac shadow (Fig. 9).

#### REVIEW OF THE LITERATURE

A review of the literature reveals surprisingly few of these cases reported. Polak,<sup>10</sup> in 1923, was able to find only 26 cases in the literature, all of which were of the anterior type whereas his own case was of the posterior type. This, however, does not represent the true proportion of these types since most of the cases in our series have been of the posterior variety. His report, no doubt, represents less than the actual number since many cases were not diagnosed due to difficulty in recognition by physical examination and lack of development of the technique of roentgen examination. Also, not all of the American cases were included in this review. Frick,<sup>8</sup> in 1910, reported 13 cases of the anterior type and 11 cases of the posterior type including 3 of his own cases. These are the only reports of large series of cases. Barjon<sup>2</sup> reports a case in which the exudate entered the esophagus and was vomited and resulted in spontaneous cure. Devic and Savy<sup>6</sup> report a similar case. Belot<sup>4</sup> reports a case in which the pus entered the trachea or a main bronchus and was coughed up. The effect of pressure on these posterior mediastinal structures, as described by Dieulafoy,<sup>7</sup> has already been referred to. Wessler and Jaches<sup>14</sup> report an interesting case in a



baby three months old. At operation, 6 ounces of pus was removed from the left anterior mediastinal pleural cavity and the shadow on the plate then disappeared.

#### CASE REPORTS

Our series comprises 15 cases, 6 of which were empyemata, all of the posterior type and proved by thoracentesis. One patient, while in the hospital, developed a right-sided pleural effusion during the course of a pneumonia (Fig. 7). The association with pneumonia suggests very strongly the purulent nature of the effusion but since thoracentesis was not done this could not be determined definitely. The patient made an uneventful recovery. One other patient presented a similar picture, and likewise recovered. Four are cases of dry pleurisy representing the healed stage of a mediastinal pleural effusion. In the other 3 cases aspiration was not done so that it could not be determined whether the effusion was serous or purulent. The clinical picture is usually of value in such cases since high fever, prostration and toxemia would indicate a purulent effusion. Three cases had tuberculosis which was demonstrated both by physical and roentgen examination. Seven cases had pneumonia on admission or just prior to admission into the hospital. One case (a dry pleurisy) had pneumonia in childhood. The remaining cases gave histories of respiratory infections before admission to the hospital, some of which were suggestive of pneumonia. This series demonstrates the close association of mediastinal pleural effusion with tuberculosis and pneumonia. Most of our cases occurred in children. All except one patient recovered but death in that case was due to intercurrent infection (mastoiditis and temporal lobe abscess) after the chest condition was entirely healed.

For purposes of brevity only a few of the characteristic cases are reported in detail.

CASE I. W. R., male, aged twenty-four, entered University Hospital Oct. 29, 1928,

complaining of pain in left lower chest posteriorly, chills, fever and cough. The clinical diagnosis was probable left lower lobar pneumonia and possible empyema. Physical examination Nov. 20, 1928, revealed an area of dullness to the right of the sternum extending from the third to the sixth ribs which was interpreted as an encapsulated empyema. A plate of the chest taken at this time showed an encapsulated mediastinal empyema on the left side posteriorly with displacement of the heart to the right. The cardiac displacement to the right accounted for the area of dullness on percussion. Thoracentesis in the tenth left interspace posteriorly was done Nov. 22, 1928, and creamy gray pus obtained. A plate taken Nov. 28, 1928 (Fig. 3), showed a decrease in the size of the empyema with a partial return of the heart to its normal position. Note the increased density where the empyema overlaps the cardiac shadow. Reëxamination Dec. 28, 1928, showed a further decrease of the empyema with a return of the heart to its normal position. The patient made an uneventful recovery and was discharged Jan. 29, 1929.

Three other cases in this series (not illustrated here) presented similar appearances on the films.

CASE II. A.M., female, aged fourteen, entered University Hospital Feb. 18, 1927, complaining of cough, loss of weight, loss of strength, afternoon fever, night sweats, and pain in the right lower axillary portion of the chest. She was raising large amounts of yellow-green pus. Her temperature was of the septic type during most of her stay in the hospital. A roentgenogram of the chest shortly after admission showed a shadow along the right heart border and extending out over the diaphragm (Fig. 4). Note the origin of the fluid from the mediastinal pleura. Thoracentesis was done and purulent fluid obtained which showed many pus cells but no tubercle bacilli. Plates were taken at intervals over a period of fourteen months and some of these are reproduced here to show the steps in the healing of the mediastinal empyema. The last plates taken April 28, 1928, show a mediastinal pleurisy as the end stage of the infectious process illustrating the characteristic picture of the healed dry pleurisy (Fig. 5).

Four other cases in this series show a similar picture. This case is an example of what

Chauffard<sup>6</sup> has named the "pleurésie en equerre" (the right-angled type) of mediastinal pleural effusion. It is one of the rare cases in which an effusion originating in the mediastinal pleura communicated with the lateral pleural cavity in the manner of a free pleural effusion instead of becoming walled off as usually occurs.

CASE III. C.P., female, aged thirty-eight, entered the Minneapolis General Hospital May 22, 1925, complaining of spells of unconsciousness and convulsions. While in the hospital she developed a right lower lobar pneumonia which was followed shortly by an encapsulated mediastinal empyema. Roentgen examination of the chest at this time (Fig. 6) revealed a triangular shadow extending out from the right hilus toward the periphery. The heart and mediastinum are displaced to the left. The appearance simulates a double heart shadow and pericardial effusion. Roentgenoscopic examination demonstrated the posterior position of this effusion. Thoracentesis below the angle of the right scapula in the paravertebral region was done and 175 c.c. of thick green pus was obtained. This was followed by closed drainage and healing of the empyema. The patient then made an uneventful recovery.

One other case in this series (not illustrated here) presented a similar picture.

CASE IV. H.P., male, aged twenty-seven, entered the Minneapolis General Hospital April 6, 1925, complaining of pain in the right anterior chest of three days' duration, cough, hemoptysis, chills, fever and general malaise, all of two days' duration. Sputum examination revealed pneumococci. A film of the chest made on admission showed a right middle lobar pneumonia. A film of the chest made three days later showed extension of the pneumonia to the right lower lobe. Roentgen examination of the chest April 18, 1925, showed almost complete resolution of the pneumonic consolidation in the right middle and lower lobes. At this time a triangular shadow was seen extending out from the right hilus and right heart border over the diaphragm toward the periphery (Fig. 7). This is characteristic of an encapsulated mediastinal pleural effusion probably purulent in nature. The patient made an uneventful recovery without aspiration.

CASE V. C.S., female, aged fifteen, entered

University Hospital Sept. 9, 1929, complaining of purulent discharge from right ear, chills and fever. Mastoidectomy Sept. 13, 1929. Roentgen examination on admission showed bilateral bronchopneumonia and mastoiditis with cell destruction. Examination Sept. 14, 1929, showed left mediastinal empyema and healing bronchopneumonia (Fig. 8). Examination Oct. 4, 1929, showed partial healing of mediastinal empyema (Fig. 9). Examination Oct. 14, 1929, showed complete healing of the mediastinal empyema (Fig. 10). Patient later developed a temporal lobe abscess which caused death.

This case demonstrates well the triangular shadow produced by the effusion and its close relation to the cardiac shadow. Plates taken with patient supine brought out the posterior position of the effusion which was not demonstrated in the routine posteroanterior films.

#### SUMMARY

1. Mediastinal pleural effusion is not so infrequent as formerly believed and is often overlooked clinically due to difficulty in diagnosis.
2. It is generally encapsulated but may rarely occur as a free pleural effusion and extend secondarily into the lateral pleural cavity.
3. The purulent type generally follows pneumonia and should be sought for when return to normal does not occur after the usual period of illness.
4. The characteristic roentgen finding is a triangular shadow on either side of and continuous with the median shadow and from which it cannot be separated regardless of the position in which the patient is placed. It may displace the adjacent part of the lung or heart, usually the latter, to the opposite side. No cardiac pulsation is visible in this abnormal shadow.
5. In some cases typical symptoms are produced due to pressure on structures in the mediastinum.
6. Early removal is indicated in the empyema due to proximity to important mediastinal viscera.

7. In our series of 15 cases the posterior type has predominated and recovery occurred in all but one case. Six were empyemata in the posterior space and were proved by thoracentesis. All of them recovered.

## REFERENCES

1. ASSMANN, H. Die Röntgendiagnostik der Inneren Erkrankungen. F. C. W. Vogel, Leipzig, 1921, p. 251.
2. BARJON, F. Les pleurésies enkystées de la région du hile. *J. de radiol. et d'électrol.*, 1914, 1, 177-182.
3. BARJON, F. Radio-Diagnosis of Pleuro-Pulmonary Affections. Yale University Press, New Haven, 1918, p. 46.
4. BELOT, J. Un cas de pleurésie médiastine. *Bull. et mém. Soc. de radiol. méd. de Par.*, 1914, 6, 194-196.
5. CHAUFFARD, A. Des pleurésies séreuses médiastines. *Presse méd.*, 1902, 10, 363-365.
6. DEVIC, E., and SAVY, P. Les pleurésies médiastinales. *Rev. de méd.*, 1910, 30, 365; 460; 499.
7. DIEULAFOY. Pelurésie médiastine à pneumocoque. *Presse méd.*, 1896, 281.
8. FRICK, A. The different forms of mediastinal pleurisy, with report of three cases. *J. Am. M. Ass.*, 1910, 55, 2042-2048.
9. PEL, P. K. Ein merkwürdiger Fall von Empyem. *Berl. klin. Wchnschr.*, 1884, 21, 113-116.
10. POLAK, J. B. Pleuritis mediastinalis. *Acta radiol.*, 1923, 2, 461-467.
11. REHBERG. Ueber mediastinale Pleuritis. *Med. Klin.*, 1920, 16, 1033.
12. TICE, F. Posterior mediastinal pleurisy. *M. Clin. N. Am.*, 1921, 5, 157.
13. WESSLER, H. Diagnosis of encapsulated pleural effusions. *M. Clin. N. Am.*, 1920, 4, 69.
14. WESSLER, H., and JACHES, L. Clinical Roentgenology of Diseases of the Chest. Southworth Publishing Co., Troy, N. Y., 1923, p. 347.



# BONE LESIONS IN TARDIVE HEREDOSYPHILIS\*

By EUGENE P. PENDERGRASS, M.D., ROBERT L. GILMAN, M.D., and  
KENNETH B. CASTLETON, M.D.

PHILADELPHIA, PENNSYLVANIA

**T**ERMINOLOGY in speaking of hereditary syphilis has frequently been loose and misleading. Stokes<sup>72</sup> has pointed out the misuse of the terms in this connection and the tendency to use as synonyms the words "congenital" and "hereditary." He says in part:

"Heredosyphilis," essentially a misnomer, but a very convenient term may be used to include the type of infection of the child which takes place via the placenta and the maternal and fetal blood-streams. "Congenital" syphilis, though widely used in place of "heredosyphilis," may be applied more strictly to that type of the disease which follows infection of the fetus in passing through the birth canal . . . . thus a variety of acquired syphilis. . . . The child infected early in uterine life with a relatively mild type of the disease may remain asymptomatic except for developmental stigmata for months or years before showing active signs of the disease. This constitutes the tardive form of heredosyphilis.

Our main interest lies in the bone lesions of the late heredosyphilis, but we have included reference to the bone lesions of prenatal syphilis in general, making a distinction where possible between congenital and heredosyphilis except when a previous observer or reporter of cases has failed to qualify his use of one or the other terms. Whereas late heredosyphilis does not refer specifically to the age of the patient except as a relative term, we have been more interested in the type which is not recognized in the child until early adolescence, although other lesions may have appeared at an earlier age.

A résumé of the pathology involved is that specifically of congenital syphilis which together with the pathology of acquired bone syphilis illustrates in effect the fundamental processes involved in

heredosyphilis. It is to be noted that all of Wegner's work quoted in the body of this paper refers to congenital syphilis. In a previous paper, one of us<sup>56</sup> has reported in detail the roentgen findings in congenital syphilis.

## HISTORICAL

Rosen,<sup>62</sup> in 1747, was the first to direct attention to involvement of bones in prenatal syphilis. In 1793, Rosenstein<sup>63</sup> offered the first criteria of diagnosis in children with osseous syphilis. He advised a thorough examination of the inferior maxilla, the cranium and the extremities for tumors and exostoses. Bertin,<sup>9</sup> in 1810, emphasized the importance of certain exostoses and periosteal swellings in relation to congenital syphilis, and likewise observed the ivory-like hardness with which these bones cut on autopsy. He noted the periosteal response to mercury and described the case of a male infant with a pigeon-egg-sized tumor on the left greater trochanter which resolved promptly following specific treatment. Valleix<sup>80</sup> demonstrated the occurrence of epiphyseal separation at autopsy in 1834. Lancereaux<sup>37</sup> reported in 1851 on his observations in 6 cases of disease involving the nasal and cranial bones. Diday<sup>20</sup> in his treatise on syphilis in new-born children gave but little space to this subject and wrote that bone lesions were infrequently observed. In a later translated edition his editors added subsequent observations in their footnotes. In 1861 Bouchut<sup>11</sup> attributed a luetic origin to a peculiar premature induration of the shafts of the long bones, making them solid and compact and difficult to cut at autopsy. He reported also on the softening process of the epiphyseal cartilage terminating in suppuration under the periosteum. Ranvier<sup>60</sup> noted in

\*From the Department of Roentgenology and the Department of Dermatology and Syphilology, Hospital of the University of Pennsylvania, Philadelphia.



1865 the retarded ossification and epiphyseal separation occurring in the long bones. Barton<sup>7</sup> believed that periostitis and disease of the bones was rarely seen in infants with congenital syphilis, with the exception of the involvement of the nasal bones. This view was likewise held by Berkeley Hill.<sup>8</sup> It was not until Wegner<sup>87</sup> in 1870 and Parrot<sup>53,54</sup> in 1871 and 1873 that the early varieties and pathology of congenital bone syphilis were clearly defined and that a substantial differentiation was made between syphilis and rickets.

Wegner evolved a working classification based upon the first comprehensive histological study of the bones in congenital syphilis. Parrot, using a longitudinal section of long bone from a new-born syphilitic infant, demonstrated a modified layer of ossification between the epiphysis and the diaphysis. He also described the osteophytic cranial bones and the pseudoparalysis which bears his name. Parrot agreed in part with Wegner's conception of the histological process but insisted that new osteophytic formations were of the greatest significance. Cornil's<sup>16</sup> test in 1878 was one of the first to include a comprehensive amount of material on the bone lesions of hereditary syphilis and included a lengthy critical discussion on the newer pathological studies announced in that decade by Wegner and Parrot. Subsequent case reports and discussion in the late nineteenth century included those of Feulard,<sup>23</sup> Sutherland,<sup>75</sup> Morgan,<sup>50</sup> Apert,<sup>5</sup> Cuff,<sup>18</sup> and Fraenkel.<sup>26</sup>

#### INCIDENCE AND INVOLVEMENT

Fournier<sup>25</sup> found bone disease in 82 of 212 cases of hereditary syphilis (40 per cent) with an age incidence ranging from three to twenty-eight years and with a mean of twelve. Hochsinger's<sup>31</sup> percentage was the same with a smaller series of cases. Villemin<sup>81</sup> found bone changes in 90 of 200 cases (45 per cent) while Dennie's<sup>19</sup> series of 50 cases of bone syphilis represented 6

per cent of his total heredosyphilitic patients.

Most observers have noted that the ends of the long bones are most generally involved, particularly the tibia and the bones of the elbow. Wegner found the inferior extremities of the femur and humerus to be most commonly involved in his cases, but his patients represented only the lesions of infancy. Abt,<sup>1</sup> Villemin, Gaucher,<sup>28</sup> Weber,<sup>86</sup> Ménard, Le Moine, and Pénard,<sup>46</sup> and Broca,<sup>13</sup> agree on the frequency with which the long bones are attacked, particularly the tibiae.

Stokes in 202 cases of hereditary bone syphilis found cranial bosses in 43 per cent, sabre tibiae in 43 per cent, saddle nose in 30 per cent, and enlarged epiphyses in 13 per cent. He also noted a general osseous over-development, particularly in the heaviness of the limbs and columnar massiveness of the bony frame with a lack of modeling of the lower extremities. In Stokes' experience, Charcot joints and spondylitis are of rare occurrence. Tubby<sup>78</sup> and Villemin also agree on the rarity of spinal involvement. Levy-Bing and Duroeux,<sup>41</sup> and Addison,<sup>3</sup> reported on cases of Charcot knee in sixteen year old patients. Gaucher believed that suppurative osteoperiostitis was of unusual occurrence. Villemin commented on the rarity of clavicular involvement, while Tubby found the incidence of rib and clavicular involvement to be about equal. Wegner in his original communication noted that prenatal bone involvement occurred in several long bones at a time. Dennie's recent experience led him to believe that multiple bone involvement occurs only in heredosyphilis—that it may be simultaneous but usually one bone after another is affected.

The majority of active bone disease in heredosyphilis occurs between the ages of five and twelve with the possibility of sabre shin appearing up to the fifteenth year (Tubby). Stokes, quoting Fournier, extends the period of late bone manifestations from three to twenty-eight years with

TABLE I  
REPRESENTATIVE CASES OF TARDIVE HEREDOSYPHILIS; BONE LESIONS IN PATIENTS OF TWELVE OR OVER

Author	Date	Patient	Lesions	Onset	Additional Findings
Post <sup>59</sup>	1898	Man of 22	Swollen knees		Scars at angle of mouth, teeth, deafness, and corneal scarring.
Hutchinson <sup>32</sup>	1900	Man of 28	Thickened tibiae with chronic periostitis of the femur		Stigma, eyes and nose.
Abt <sup>1</sup>	1903	Boy of 15	Involvement of knees, elbows and tibiae. Swollen ankles	At age 10	Hutchinsonian incisors.
Lévy-Franckel <sup>42</sup>	1906	Man of 55	Suppurative osteomyelitis with red, swollen, ulcerated, feet.	At age 53	Had interstitial keratitis at the age of 4 years.
Gaucher <sup>28</sup>	1906	Man of 37	Suppurative osteomyelitis of the skull. Luetic spina ventosa.	At age 30	Additional stigmata of heredosyphilis.
Gaucher <sup>28</sup>	1906	Man of 33	Tibial osteoperiostitis with abscess	Traumatic, at age 6	Stigma, nose and teeth.
Tscherniawski <sup>77</sup>	1906	Boy of 15	Osteochondritis of the tibiae. Luetic spina ventosa		
Stadler <sup>70</sup>	1907	Boy of 17	Pain in forearms and ankles with sabre tibiae	At age 8	Roentgen confirmation.
Villemin <sup>81</sup>	1908	Boy of 14	Osteochondritis of the tibiae	At age 6	Night pains.
Parkinson <sup>55</sup>	1908	Girl of 21	Large tibiae, ulnae, and lower femora. Tender joints with fluid		Interstitial keratitis at the age of 8 years. Infantile. Submentally.
Gaucher and Giroux <sup>29</sup>	1908	Woman of 24	Ulceration of the leg	At the age of 15, 18, 22	
Dittrich <sup>21</sup>	1909	Girl of 12	Swelling at the center of the left tibia with ulceration	Traumatic 6 mos. ago	Other signs of heredosyphilis.
Saunders <sup>65</sup>	1910	Girl of 12	Enlarged knees and periostitis of tibiae	At age 11	
Mann <sup>45</sup>	1912	Girl of 12	Involvement of knees, hips and shoulders		Subsequently developed an interstitial keratitis.
Trimble <sup>76</sup>	1912	Girl of 21	Symmetrically enlarged and thickened tibiae, with a rarefying osteoperiostitis	At age 5	

TABLE I (Continued)

REPRESENTATIVE CASES OF TARDIVE HEREDOSYPHILIS; BONE LESIONS IN PATIENTS OF TWELVE OR OVER

Author	Date	Patient	Lesions	Onset	Additional Findings
Levy-Bing and Duroeux <sup>41</sup>	1913	Girl of 19	Multiple hyperperiostitis of long bones	At age 12	
Mouchet and Meaux-St. Marc <sup>51</sup>	1913	Woman of 24	Swollen and painful right elbow	Traumatic few weeks.	Other stigmata.
Mouchet and Meaux-St. Marc <sup>51</sup>	1913	Man of 20	Swollen and painful wrists. Suppurative osteitis	Recent trauma	Previously had an osteomyelitis of the ankle.
Sequeira <sup>67</sup>	1914	Boy of 16 Girl of 12	Osseous syphilis of the nose	Recent trauma	
Pinard <sup>67</sup>	1921	Man of 78	Clavicular gumma	At age 73	Other stigmata of heredo-syphilis.
Antonin <sup>4</sup>	1922	Woman of 30	"Recurring evidence of bone syphilis"	Traumatic at age 7	
Spackman <sup>68</sup>	1922	Boy of 16	Small stature		Abdomen distended with fluid. Liver-spleen large.
Spence and Tittle <sup>69</sup>	1923	Boy of 15	Ankylosed elbow, ulcer at sternoclavicular joint. Sore and painful joints		Ascites and marked anemia.
Steinmetz <sup>71</sup>	1923	Man of 32	Large thick femora and tibiae. Osteomyelitis and periostitis	At age 23	Positive blood Wassermann.
Roederer <sup>61</sup>	1923	Boy of 17	Osteoporosis with medullary gumma	Traumatic at 4 and recurred 14	Positive blood Wassermann.
Bowman <sup>12</sup>	1923	Man of 29	Involvement of left wrist and ankle		Hutchinsonian incisors and atrophic shoulder.
Yampolsky <sup>88</sup>	1923	Boy of 12	Large elbow and a Charcot joint	Traumatic	Positive blood Wassermann after treatment.
Menninger <sup>48</sup>	1926	Man of 22	Osteoporosis of the skull. Giantism.		Dental stigma. Bosses. Submental development.
Rouillard and Calmels <sup>64</sup>	1926	Woman of 44	Multiple osteoarthropathies. Polyarthritis.	Duration 4 years	Positive blood Wassermann.
Meurisse <sup>49</sup>	1927	Woman of 23	Joints of knees—hips		Facial and dental stigma. Positive blood Wassermann.
Laroche and Barthes <sup>40</sup>	1927	Woman of 20	Numerous bones involved "pleonostose"		Positive blood Wassermann.

a rarity of occurrence past thirty. Bone stigmata of tardive heredosyphilis are in the main the result of osteitis and ossifying periostitis in the earlier months of life, which produce the diffused thickening and exostoses observed. Syphilitic bone disease in early adolescence and early adult life appears almost constantly in association with trauma (see Table I), giving additional evidence of the predilection of this process for the vulnerable portions of the extremities.

#### PATHOLOGY

The earliest work on the pathology of congenital bone syphilis is that of Wegner, with additional contributions by Parrot. In 1922 Holland<sup>79</sup> published an excellent article on the bone changes found in congenital syphilis. His findings are very similar to those described by Wegner. They describe the predominant lesion as being osteochondritis and divide the findings into three stages depending upon the severity of the process.

*First Stage.* The zone of temporary calcification which represents the limit of advancing ossification at the ends of the diaphyses is increased in thickness. The cartilage cells continue to proliferate in the adjacent zone epiphyses, there being no cessation of the normal changes except a retardation of the ossification process. This results in the yellow zone of temporary calcification becoming abnormally wide, and it may measure as much as 2 or more millimeters in width. Holland states that "in early lesions there may be no recognizable abnormality." When this is true it is difficult to recognize the changes by the microscope unless spirochetes can be demonstrated.

Ossification of the zone of temporary calcification may be checked except around some of the large vertical vessels which unite the diaphysis and epiphysis. When this occurs the diaphyseal border of the zone of temporary calcification becomes notched and serrated. Wegner states that

this zone has a pinkish white, glistening appearance and is very brittle.

*Second Stage.* The process is much more evident. The cartilage cells continue to proliferate, and there is an increase in the calcification of the intercellular matrix. The ossification is still retarded. Holland's description of this stage is quoted in its entirety.

Owing to curtailment of the normal vascular supply, portions of the epiphyseal cartilage may become degenerate and not undergo provisional calcification and subsequent ossification. The vertical vessels, however, which unite the cartilage with the diaphysis are relatively large vessels, and the blood supply from these are less likely to be cut off. Provisional calcification and subsequent ossification usually proceed, therefore around some, at any rate, of these.

In consequence, narrow processes, or broader tongues, of red marrow project from the diaphysis into the epiphyseal cartilage and alternate with tongues of cartilage which project into the diaphysis. The line of junction of the epiphysis with the diaphysis then appears dentate, and the zone of provisional calcification follows the irregular line of interlocking teeth.

Further, as growth proceeds the level at which provisional calcification should normally take place may reach transverse chondral vessels of which the blood supply has not been interfered with. Around these vessels, in the epiphysis beyond the degenerate portions of cartilage, calcification, and subsequent ossification take place in due course. This leads to the occurrence, in the epiphyseal cartilage at a distance from the main epiphyseal limit of diaphyses, of red streaks and dots which are each bordered by a narrow zone of yellow calcification. Transverse chondral vessels have become visible to the naked eye, and moreover have become surrounded by a visible zone of calcification. Now, not only is the junction of the diaphysis with the epiphysis dentate but transverse zones of provisional calcification are seen at different levels. The disturbance of the normal pattern is extreme.

The cartilage lying upon the deepened zone of provisional calcification may not be interrupted by vertical vessels surrounded by



provisional calcification. Then calcification preparatory for ossification commences in the cartilage about a transverse vascular arch at the time it should normally appear at this arch. When this takes place two zones of provisional calcification separated by a zone of cartilage are seen. Ossification may then proceed toward the epiphysis from this transverse vascular arch. In this way a more remarkable appearance is produced—a yellow, usually irregular line of provisional calcification is followed by a zone of red marrow, in which osseous trabeculae can be felt with the point of the scalpel, and this red marrow is separated from the red diaphyses by a second—the original, yellow, abnormally deep—zone of provisional calcification.

This zone has a bluish transparent color, very soft consistency and cuts like gelatin. Wegner compares this stage to rickets.

*Third Stage.* There is a further progression of the osteochondritis and in addition diaphysitis and epiphysitis.

The changes seen in the second stage become more pronounced and there is now definite evidence of fibrosis. In advanced inflammations the fibrosis is followed by a development of a dense granulation tissue. This granulation tissue causes necrosis and absorption of bone which when present proximal to the zone of temporary calcification causes a weakening of the area and it may result in an infraction of the diaphysis which results in a condition called by Parrot, pseudo-paralysis. Wegner states that after granulation tissue has replaced the normal vasculature there may be actual pus formation.

This process may be distributed throughout the diaphysis and similar changes may result. When the diaphysis is involved, frequently the process extends to the periosteum. Most observers believe that the changes in the bones are due to the presence of the spirochetes or their toxins. Fortunately for the roentgenologist, the spirochetes seem to have a predilection for the bones probably because of their rich blood supply.

*Summary of the Pathological Changes.*

(a) Abnormal cartilage cell proliferation which causes slight swelling of the epiphysis.

(b) Widening of the zone of temporary calcification, with occurrence of secondary zones of calcification.

(c) Retardation of the transference of calcified cartilage.

(d) Fibrosis and granulation tissue, with subsequent necrosis in the marrow at the diaphyso-epiphyseal junction, which causes weakening of the bone at this point, with possible subsequent infraction of the diaphysis (or the so-called epiphyseal separation).

(e) The outermost cells near the perichondrium are more regular and the calcified zone is more regular than near the center.

(f) The chondral and vascular canals are enlarged, the vessels are few and irregular.

Virchow<sup>82</sup> called rickets "parenchymatous bone inflammation." Wegner called congenital syphilis "osteochondritis" or "cartilage inflammation." In rickets, there is increased vascularization of the tissues with diminished calcification; in syphilis there is diminished vascularization and increased calcification which may be general. Holland says:

Focal areas of syphilitic inflammation occur with considerable frequency in the medulla of the diaphysis at a distance from the epiphysis. This fibrosis is associated first with cessation of deposit of bone and later with erosion of trabeculae of bone and calcified cartilage present. In early stages the areas of fibrosis are seen by the naked eye as paler, pink areas in the red marrow of the diaphysis, in later stages the granulation tissue is slaty blue or yellowish, frequently gelatinous, and the affected area feels soft.

Parrot emphasizes the existence and the importance of the osteophyte in the histogenesis of the process. He epitomizes the stages as a primary periosteogenesis with a formation of osseous tissue from the periosteum, followed by a calcareous incrustation of cartilage with subsequent gelatinous transformation and softening of the bone. The lesion, primarily syphilitic,

later has more resemblance to rachitis. Waldeyer and Kobner<sup>84</sup> in a study of 12 cases confirmed the histology of Wegner. They concluded, however, that not all the phenomena occurring between the epiphysis and diaphysis were due to an osteochondritis but rather to formation of syphilitic granulations comparable to gummatous tissue, and the soft tissue between the bone and cartilage was compared to embryonal tissue.

Herxheimer,<sup>39</sup> writing in 1907, emphasizes the major points brought out by Wegner a generation previous. Ware,<sup>85</sup> from his roentgen studies of syphilitic long bones, concludes that acquired or hereditary cases are similar and in their development start with a circumferential thickening of the periosteum, resulting in an increased diameter and finally the appearance of gummatous deposits together with a lengthening and bowing of the bone. Karsner,<sup>35</sup> in 1910, using the femur of a still-born child, demonstrated an irregular yellowish line at the epiphyso-diaphyseal junction at the lower end of the femur (Wegner's line), which he pointed out was not fatty degeneration but represented a similar excess of connective tissue as seen elsewhere in such processes.

MacCallum<sup>44</sup> confirms Wegner's osteochondritis as the most definite and characteristic lesion found practically always in syphilitic new-born infants. The process is most distinctly developed at the epiphyseal ends of the long bones about the knee. The normally thin, even and pearly-gray epiphyseal line becomes thick and jagged and assumes an opaque yellowish-white color. Microscopically, a layer of granulation tissue forms (essentially gummatous) along the side of the bone which becomes prone to necrosis and disintegration. This involves the most recently formed bone, and the delay in the process of bone formation ultimately results in a débris of minute bony fragments. New growth comes from the periosteum and perichondrium.

Thus far we have dealt exclusively with

early bone lesions in congenital syphilis without mention of the variant pathological types seen in the later heredo-type—the syphilis hereditaria tarda. This latter group of cases may have features suggestive of acquired bone syphilis and in most instances shows evidence of a bone involvement early in childhood—the usual osteochondritis and periostitis. Dennie's conclusion from a series of 50 cases of congenital bone syphilis is that the periostitis of the long bone is comparable to the acquired type. His most typical pathological finding in late hereditary syphilis is a proliferative thickening of the cortex with a relatively narrowed medulla as a result of the encroachment. A coincidental deposition of lime salts in the Haversian canals and in the lymphatic spaces produces a bone of ivory-like hardness. Blood vessels and lymphatics are cut off with diseased portions and either absorbed or cast out as sequestra. An osteomyelitis may follow if secondary infection ensues. A local interference with the blood supply just beneath the periosteum by a deposit of connective tissue or new bone cells in the Haversian system will result in a subperiosteal gumma.

Sutherland and Mitchell<sup>74</sup> suggest that the bone lesions of congenital syphilis are found in the secondary stage of the disease mainly because of their ephemeral characteristics. The older the child, the fewer the bones that are affected.

Most pathologists, of which MacCallum is one, believe that the bone lesions in the tardive type of heredosyphilis are similar to the tertiary manifestations found in acquired syphilis. It is difficult to comprehend how changes could lie dormant for such a long time and become so definite without there being some exciting cause such as trauma. The usual syphilitic affections involving the bone in the tardive type is as follows according to MacCallum:

1. "Periosteal gumma formation with necrosis of the underlying bone, followed by ulceration and exposure through the skin or by extensive osteophyte growth."

It is thought by some that the periosteal inflammation may form a part of the secondary stage of syphilis, but there has been no proof of the contention.

Essentially it seems that the periosteum is involved first. This is separated from the bone by the inflammatory infiltration composed chiefly of mononuclear wandering cells. Following the rupture of the periosteum the skin may break down and the underlying tissues are subject to further infections. This may lead to:

2. Gummatous osteitis or osteomyelitis with necrosis and erosion of the directly affected part and rarefaction or sclerosis of the surrounding bone." A new growth of spongy bone may be produced on the surface of the old cortex, forming in this way a convex surface, or osteomyelitis which can be felt as elevations. There is another form of new production of bone which is not limited to the activity of the periosteum. The Haversian system and the cancellous bone of the interior are usually the sites of the process. The bone becomes dense and hard.

"Still another type and possibly more characteristic are the gummatous lesions which arise in the periosteum or the interior of the bone. In the first place the gummatous tissue may extend along the blood vessels into the bone enlarging their canals and eroding the bone to a peculiar wormeaten appearance and in untreated cases the bone may be entirely destroyed." Osteophytes surround the area which make it seem deeper. In all of these processes there is evidence of rarefaction or bone destruction and condensation or sclerosis due to bone production.

Gummas found in the marrow exist as gelatinous patches, often bright yellow from their content of fat. They may occur frequently enough to become almost continuous. The process may attack the cortex and subsequently cause the periosteum to lay down even bone. This causes a spindle-shaped dilatation of the bone. Canals or fistulae are formed through the

cortex and except for the absence of sequestra, the bone comes to look like the end-result of an ordinary osteomyelitis.

The joints, bursae and tendon sheaths often reveal a susceptibility to syphilis. There may be an accumulation of a watery exudate or the formation of a syphilitic granulation tissue in the synovial membrane. This may ulcerate and cause a great proliferation of the adjacent unaffected membrane and synovial villi. This joint affection no doubt is secondary frequently to the appearance of gummatous infiltration of the epiphysis.

This process often destroys the cartilage and after a long time may heal by obliteration of the cavity by fibrous tissue.

Charcot's joints or tabetic arthropathies were originally described as being due to trophic disturbances. Kienböck,<sup>36</sup> however, feels that the process follows fractures which result from complete analgesia and the rarefaction of the bone so that even a slight strain may break off a part of the bone. Kienböck described two forms, hypertrophic and atrophic. The hypertrophic form is due to tears and fractures with hemorrhage into the stretched joint cavity. In the atrophic form there is no attempt at healing, atrophy being the outstanding finding.

#### CLASSIFICATION

Several groupings may be made in the attempt to classify the variety of bone lesions of both congenital syphilis and late heredosyphilis. A catalogue of bone lesions based on pathology alone is inadequate, as a working classification should include likewise factors of incidence, age and involvement. Abt has grouped the bone and joint lesions as follows:

1. Periostitis. Between the ages of 5-12 years
2. Gummatous periostitis
3. Gummatous osteomyelitis. A late occurrence in heredosyphilis.
4. Arthritis { prominent frontals  
prominent laterals

5. Cranial involvement { asymmetrical prominences  
hydro- and micro-  
cephalus

Gaucher's<sup>27</sup> classification, 1911:

1. Osteoarthritis hypertrophic
2. Exostoses, multiple
3. Gummatous osteitis and periostitis
4. Suppurative osteomyelitis { spina ventosa  
syphilitica  
mal de Paget  
syphilitica
5. Epiphyseal osteitis "tumeur blanche" (hypertrophic osteitis infancy to adult. Knees and ankles. Ankylosis)
6. Arthraglia

Fitzwilliams' classification:<sup>24</sup>

1. Syphilitic "epiphysitis" (perichondritis)
2. Syphilitic dactylitis at 2-3 years of age. Rare
3. Periostitis—most common
  - a. Local—generally long bone, i.e., tibia following trauma—commences at 6 years
4. Syphilitic osteomyelitis (gummatous replacement)

Broca, in discussing the tardive type of heredosyphilis, grouped his cases into circumscribed osseous gummata, particularly at the elbow and the knee, osteomyelitis gummosa diffusa (sabre shin, involvement of the upper facial bones, and infantilism).

As a classification for all types of congenital syphilitic bone disease, Dennie divides his cases as follows:

1. Productive periostitis—long bones
2. Syphilitic disease of the epiphyses
3. Bursitis
4. Periarticular infiltration
5. Syphilitic epiphysitis, i.e., the knee
6. Osteitic periostitis—long bones. Going on to possible
  - a. Secondary osteomyelitis or
  - b. Subperiosteal gumma
7. Syphilis of the skull { hyperplastic osteitis  
(bosses)  
(osteoporosis)
8. Dactylitis—before the 3rd year

#### ROENTGENOLOGIC CLASSIFICATION OF EARLY CASES OF CONGENITAL BONE SYPHILIS

We have found the following classification satisfactory and descriptive.

1. Epiphysitis—3 stages: first, second and third, all epiphyses including carpal and tarsal bones.
2. Osteochondritis—3 stages. All bones.
3. Diaphysitis—all bones: rarefying osteomyelitis, condensing osteomyelitis, and combination of the two processes.
4. Periostitis.

#### ROENTGENOLOGIC CLASSIFICATION OF TARDIVE HEREDOSYPHILIS

1. Synovitis and periarticular infiltration.
2. Hypertrophic and atrophic changes in the joints with or without loose bodies.
3. Diaphysitis—all bones, rarefying osteomyelitis (generalized, localized), rarefying osteitis localized (gumma), condensing osteomyelitis.
4. Periostitis—all bones, Parrot's node-skull, dactylitis.
5. Unusual manifestations (osteitis fibrosa cystica).

#### DIAGNOSIS

Late bone manifestations, occurring most frequently between the fifth and the twelfth year, involves the tibia and elbow with greatest frequency. Multiple bone involvement is more often seen with joint changes usually secondary. While in infancy, osteoperiostitis, when it occurs, is found as a generalized lesion affecting mainly the ends of the long bones, the tendency in later childhood is involvement principally or solely of the shaft. Here, injury plays an increasingly important part in the bone selectivity directly proportional to the age of the child.

The onset is gradual and generally accompanied by pain (worse at night) often described by the parent subsequently as "rheumatic" or "growing pains." Weber has called attention to the absence or but relatively slight pain that is seen in some



instances. A symmetrical and tender swelling ensues with functional disability proportionate to the pain or the proximity to the joint. Subsidence of the acute process may be followed by a secondary osteomyelitis or gummatous ulceration, but more commonly the typical bone deformities develop, ranging from but slight roentgen changes to the markedly bowed and thickened sabre tibiae. The less common gummata, osteoporosis, and Charcot joint changes are recognized and diagnosed exactly as in the acquired form of the disease.

Additional evidence of heredosyphilis may often be the deciding factor in the early recognition of minor bone changes (i.e., eyes, facies, teeth), and while the complement fixation test is a valuable adjunct in children it tends to be of considerably less value in the older patient (Stokes and Dennie).

By far the most exacting and the ultimate in diagnostic criteria are the changes seen in the roentgen examinations of the bones. The value lies less in the clinically recognizable case than in the absence of obvious bone changes in which typical and consistent changes are demonstrable only on roentgen examination, and often constitute the sole clue to diagnosis.

No attempt will be made to describe the roentgen findings in the early cases of congenital syphilis as these have been fully described in an article by Pendergrass and Bromer.

#### SYNOVITIS AND PERIARTICULAR INFILTRATION

Clutton<sup>15</sup> described this condition in 1886. Subsequently Churchman<sup>14</sup> in an excellent article reviewed the literature and added one of his cases to Verneuil's original group, making a total of 26 cases up to 1909. He described the pathology as: (a) luetic bursopathy secondary to luetic arthropathies (luetic syphilis with swelling); (b) luetic bursopathy independent of any joint involvement. There are three types: (1)

congestive bursitis, (2) hydrops, and (3) gumma of the bursa.

The diagnosis is dependent upon:

- (a) Presence of constitutional syphilis.
- (b) Spontaneous development independent of trauma.
- (c) Slow evolution and chronicity.
- (d) Marked absence of pain, tenderness, or functional disability.
- (e) Symmetry of bursopathies.
- (f) Usual sites are knees and elbows.
- (g) Absence of joint involvement.
- (h) Response to specific treatment.

Clutton's joints of congenital lues are exactly similar clinically to luetic bursopathy or Fournier's "pseudo-tumeur blanche syphilitique." Coues<sup>17</sup> and Lane<sup>38, 39</sup> have described this condition and have added several cases.

The chronic synovitis and periarticular infiltration found in hereditary syphilis frequently manifests itself as a symmetrical chronic synovitis of the knees, "false tumor albus," exceedingly resistant in character according to Jones and Lovett.<sup>34</sup> The joints may be painful and slightly tender to pressure. In one case a number of the joints were affected and some had progressed into the stage that is very similar to the tertiary stage of acquired syphilis described by Jones and Lovett. The roentgen findings are not typical, but do show some periarticular swelling and possibly some effusion into the joint evidenced by an elevation of the patella. According to Jones and Lovett:

The essential pathology results from a chronic inflammation produced by a periarthral invasion by the *Treponema pallidum*. A proliferation of fixed cells and an inflammation with small lymphoid cells and plasma cells most frequently involves the periarthral tissues and the walls of the nutrient arteries. The adventitia is the common initial focus of this lesion which develops into a small nodule, destroys the elastic tissue of the media, and produces proliferation of the intima with subsequent narrowing of the lumen. For this reason the blood supply is diminished and coalescence of adjacent granulomata favor degen-

eration and necrosis which result principally from occlusion and thrombosis in the capillaries and involvement of the vasovascularum in the larger arteries.

#### HYPERTROPHIC AND ATROPHIC CHANGES IN THE JOINTS, WITH OR WITHOUT LOOSE BODIES

In most cases one does not find any cartilaginous changes in the joints nor any evidence of hypertrophic changes. Baetjer and Waters<sup>10</sup> state that when such changes occur they can be regarded as evidence of some lesion other than lues. These authors also call attention to a new bone formation

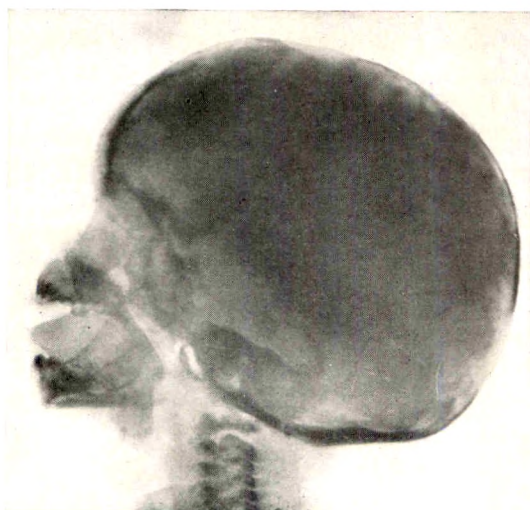


FIG. 1. Rarefying and condensing osteomyelitis of the skull.

which occurs at the chondroperiosteal junction. This new bone formation with the periarticular swelling is thought to be characteristic of lues.

When extensive changes occur in the joint it is usually due to an extension from a primary gummatous process in the cancellous bone adjacent to the joint.

#### DIAPHYSITIS

Several types of diaphysitis can be recognized on the roentgenogram: (1) rarefying and condensing osteomyelitis (generalized or localized) (see Fig. 1); (2) condensing osteomyelitis (see Figs. 2

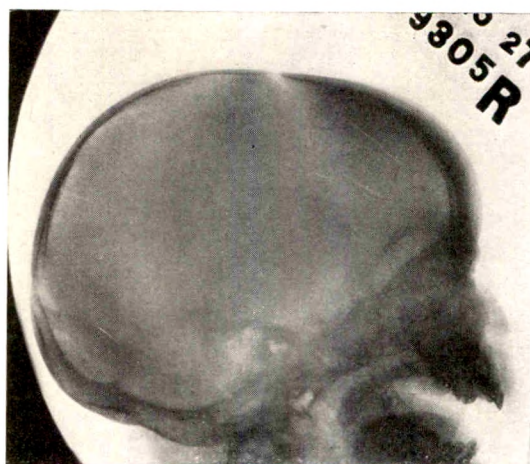


FIG. 2. Condensing osteitis in boy aged six years. (Illustration loaned by Dr. R. S. Bromer.)

and 3); (3) rarefying localized osteomyelitis. Luetic osteomyelitis may have the same appearance as any other type of infectious osteomyelitis (see Figs. 23 and 24). There may be an irregular density of the bone, with sequestration, and there may or may not be draining sinuses.

The localized type of diaphysitis or osteomyelitis has been recognized for years and was considered as an important sign in diagnosis long before roentgenograms were made (see Figs. 4 and 5). These localized areas are frequently found on the

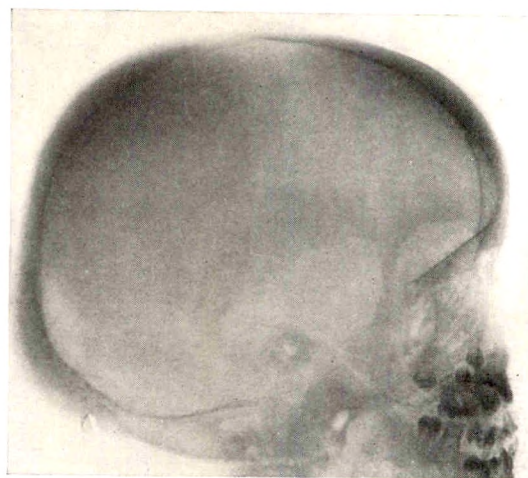


FIG. 3. Condensing osteitis of the skull in a boy eight years of age. (Illustration loaned by Dr. R. S. Bromer.)





FIG. 4. Localized diaphysitis (punched-out area) adjacent to the diaphyso-epiphyseal junction. Note the preservation of the zone of temporary calcification. (Illustration loaned by Dr. R. S. Bromer.)

tibia but may be found on any bone. The roentgen appearance is that of a localized area of bone destruction surrounded by dense eburnated bone.

The roentgen appearance of the second type of osteomyelitis is that of a widened and thickened shaft. The coarse trabeculation of the bone and thickened cortex is probably a later stage of the process de-



FIG. 5. Same case after treatment.

scribed above. Lues with multiple gumma formation causes bone destruction of some of the bone trabeculae in the center of the shaft, and this is surrounded by much formative activity, and ultimately the bone may become so dense that it is difficult to distinguish bone trabeculae in the ordinary roentgenogram.

Osteomyelitis or diaphysitis is nearly always associated with periostitis.

Rarefying osteitis is recognized on the roentgenogram as a localized area of bone



FIG. 6. Localized area of infective osteomyelitis adjacent to the diaphyso-epiphyseal junction. Note the destruction of the zone of temporary calcification. Compare with Figure 5 which is a case of congenital syphilis. These two can usually be differentiated clinically. (Illustration loaned by Dr. R. S. Bromer.)

destruction adjacent to the diaphyso-epiphyseal junction. This lesion is rather typical and almost diagnostic, although it may be confused with localized osteomyelitis of some other type of infection (see Fig. 6).

#### PERIOSTITIS

Periostitis may be localized or generalized, and, as stated above, it usually accompanies diaphysitis, but it may occur



alone. In the early stages of periostitis the diagnosis is fairly easy to make as the periosteal new bone formation is usually laid down perpendicular to the long axis of the bone (see Fig. 11). One must be careful to remember that this appearance should be differentiated from the perpendicular striation of osteogenic sarcoma. In ordinary osteomyelitis the periosteal new bone is laid down parallel to the shaft.

We have been unable to find any explanation for the perpendicular periosteal new bone formation in syphilis. It is assumed therefore that ossification of bone proceeds around the larger vertical periosteal vessels entering the cortex in which the blood supply has not been interfered with. Dactylitis or periostitis of the bones of the hands and feet is an exception to this rule. In these areas, the bone is laid down parallel to the shaft. Parrot's node is a small osteophyte which is due to periosteal activity in the skull.

The unusual manifestations of bone pathology in syphilis are the occurrence of osteitis fibrosa cystica, bone cyst or bone cavity as described by Stoloff. The roentgen appearance is a localized area of bone destruction with some expansion of the cortex. The cyst may be lobulated or loculated and is usually situated at the end of

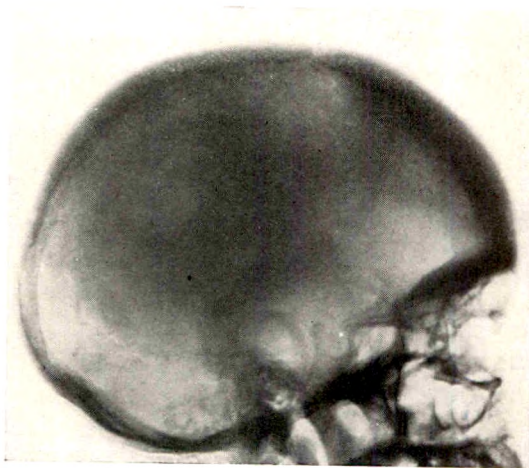


FIG. 7. Condensing type of osteitis in skull. No areas of rarefaction could be demonstrated.

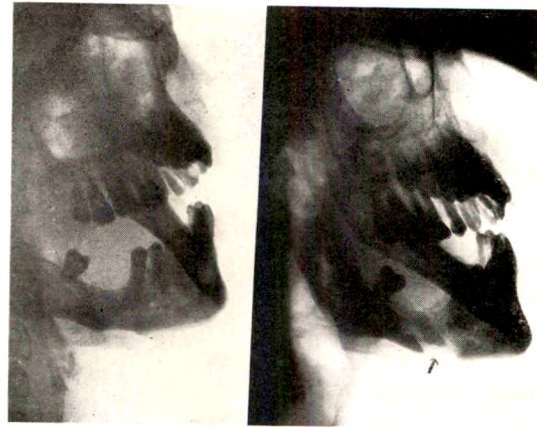


FIG. 8. In the illustration on the right the area of luetic osteomyelitis with sequestrum formation can be easily seen. The illustration on the left shows the same jaw after treatment was instituted. The bone has now assumed a normal appearance.

the diaphysis. Pommer and Looser<sup>58</sup> feel that these areas are an expression of bone trauma, hemorrhage occurring at the time of the trauma with subsequent bone atrophy. Ironside<sup>33</sup> has reported a case of congenital syphilis in which von Recklinghausen's disease or osteitis fibrosa cystica has been observed. Barrie<sup>6</sup> has written an excellent article on the association of these lesions.

#### REPORT OF A CASE

T., male, aged twenty-five, was first seen in the out-patient service on Oct. 27, 1927, complaining chiefly of an open sore on the arm, and an abscess of the jaw (see Fig. 26).

Two years previously the patient had had a tooth extracted because of malposition. Later, a second extraction resulted in an abscess from which sequestra have appeared at intervals. For the past month the right knee has been swollen but not painful and for the past two weeks he has had an open sore on the right arm which has discharged pus.

At the age of five he was kicked by a horse and since then has had a painless lump in his abdomen which has increased slightly in size. At the age of six, his mother noticed that he was "sleepy-like". At the age of fifteen, his legs hurt him and he was regarded as "rheumatic". There was no further trouble until just prior to his present chief complaint. No



other traumatic history was elicited other than the kick from the horse and his later dental extractions.

*Family History.* His father died at the age of sixty-three with cirrhosis of the liver. His mother, aged sixty-seven, is at present under treatment for cardiovascular syphilis. His mother's pregnancies have been as follows:

1. Son, who grew to maturity and was killed in an accident.
2. Miscarriage at four months.
3. Daughter, living and well, with a negative blood Wassermann.
4. Son, in a government hospital for the insane.
5. Son, grew to maturity, killed in an accident.
6. Son, living and well, with a negative blood Wassermann.
7. Stillbirth.
8. Thomas, our patient.
9. Miscarriage at four and one-half months.
10. A son in the army, with a negative blood Wassermann.



FIG. 9. Appearance suggests beginning osteitis fibrosa cystica. This appearance may be found in the ends of the long bones when the luetic process has progressed for some time.

Of the above, we have seen and examined only the daughter (No. 3), who we believe is free from syphilis.

*Social History.* The patient completed the fifth grade at the age of thirteen and since that time has stayed at home (recluse), with no apparent interests. There has been no history of conduct disorder but rather arrested mental development. (At a subsequent examination his mental age was determined as nine years and three months.)

*Examination.* The significant findings included a markedly enlarged liver and spleen, which extended down to the anterior superior iliac spine and mesially to within 4 inches of the umbilicus. A large indolent ulceration was found over the lower portion of the right humerus and the left tibia, with exposure of the bone, and a swollen right knee. The patient presented the appearance of a freckle-faced, serious-miened adult, with a boy's build. (He weighed 90 lbs. and was 59 inches tall.) (Fig. 26.) The lower right jaw was swollen and misshapen, the teeth in poor condition, and there was a distinct clouding of the right cornea.

*Laboratory.* Oct. 27, 1927. Hemoglobin, 50 per cent; erythrocytes, 2,900,000; leucocytes, 5,800; Kolmer Wassermann reaction, 2+, Kahn, 3+, spinal fluid examination, negative; blood urea, 13 mg. per 100 c.c.; urine, negative except for a very faint trace of albumin.

Further cytological studies showed on: Nov. 2, 1927, hemoglobin, 50 per cent; leucocytes, 3,800; Nov. 21, 1927, hemoglobin, 40 per cent; erythrocytes, 2,800,000; leucocytes, 3,800; differential count: polymorphonuclear neutrophils, 61 per cent; small lymphocytes, 33 per cent; large lymphocytes, 5 per cent; large mononuclears, 1 per cent.

#### *Special Examinations:*

*Dental.* Several cavities and malposition of teeth in the upper jaw. No extractions indicated at present.

*Orthopedic.* Advised no tapping nor splinting of knee-joint until after considerable specific treatment.

*Nose and Throat.* Both faucial tonsils contain pus. Much purulent material in each nostril. Both maxillary sinuses are dark to transmitted light, and frontal sinuses transmit



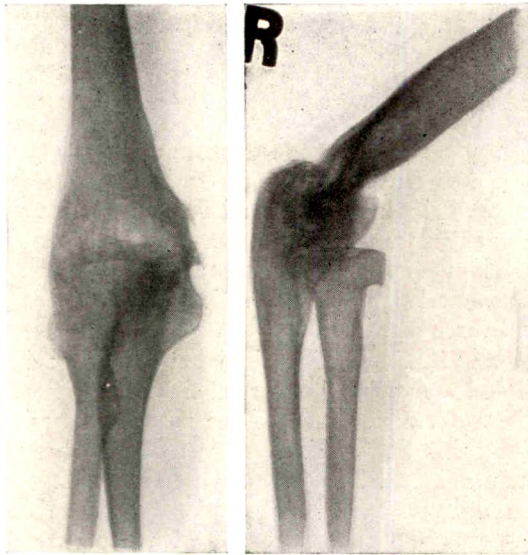


FIG. 10. There is an extensive involvement of the joint which has probably resulted because of an extension of the process from the lower end of the humerus.

light poorly, possibly because of their small size. The ears are negative.

*Roentgen Examination.* **Head:** The bones of the vault show considerable increased density. There is very little if any rarefaction and the bones of the vault are much thicker than normal. The findings are rather typical of the condensing type of osteitis seen in some cases of congenital lues (see Fig. 7).

**Lower jaw:** The left lower jaw is negative.

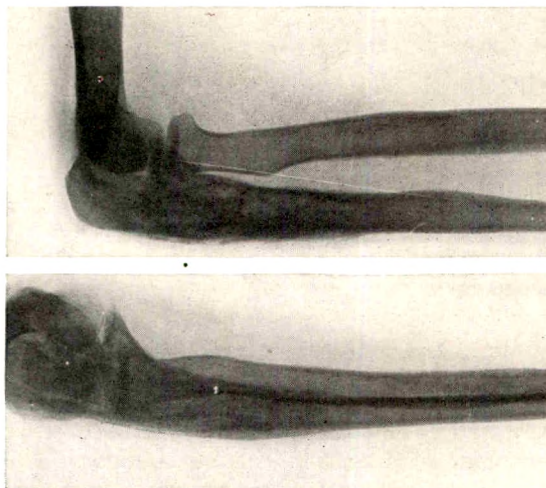


FIG. 11. Before treatment.

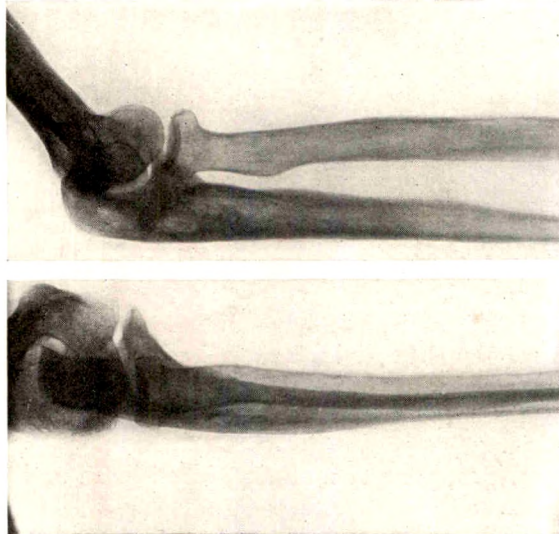


FIG. 12. After treatment.

There is a localized area of osteomyelitis in the right lower jaw. In the center of the rarefied area, there is a small area of increased density very suggestive of a sequestrum. Note the absence of any periosteal reaction or formative activity at the periphery of the diseased area (see Fig. 8).

**Shoulders:** There is an area in the upper end of the right humerus that suggests beginning changes of osteitis fibrosa cystica. In the left humerus the changes are more marked and extend almost to the articular surface. The

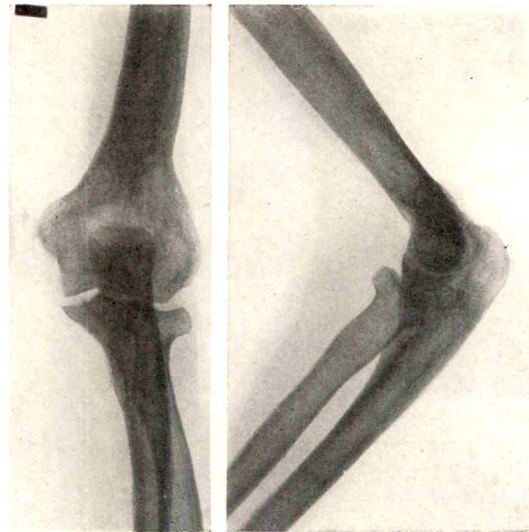


FIG. 13. End-result.



findings are rather typical of osteitis fibrosa cystica (see Fig. 9).

Elbows: Considerable atrophic and hypertrophic changes in the right elbow. The dis-

an area of rarefaction suggesting a localized area of luetic osteomyelitis. The entire right femur shows an advanced type of condensing and rarefying osteomyelitis with sequestrum

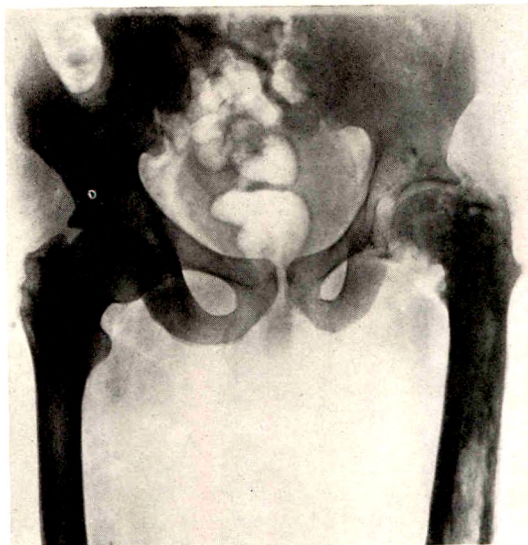


FIG. 14. Before treatment.



FIG. 15. After treatment.

ease process (gumma) in the lower end of the humerus and the upper end of the ulna probably has extended into the joint and caused the destructive process which is seen (see Fig. 10). The articular surfaces of the left elbow seem to be intact. There is an advanced osteomyelitis of the upper end of the ulna with an irregular area of rarefaction and condensation. Periostitis on the posterior aspect of the ulna is rather typical. Note the perpendicular striation (see Figs. 11, 12 and 13).

Chest: Negative.

Abdomen: There is an enlarged liver and spleen.

Spine: Negative.

Pelvis and Hips: There is an area suggesting gumma formation just above the acetabulum on both sides, especially the right, the roentgen evidence being rarefaction (see Figs. 14 and 15). The left hip joint is negative. The right hip joint shows some destruction of the cartilage and considerable hypertrophic changes with loose body formation. There is marked coxa vara. The changes in this joint are probably due to extension of the disease process from the upper end of the right femur into the joint. The greater trochanter of the left femur shows

and gumma formation. The shaft is considerably widened with thickening of the cortex due to periosteal proliferation (Fig. 16).

Knees: The examination of the right knee shows marked periarticular swelling and effusion. There has been some destruction of the articular cartilage indicated by the close approximation of the joint surfaces. There is a slight tendency toward loose body formation (Figs. 17, 18, 19 and 20). The lower end of the femur and the upper end of the tibia show areas of multiple gumma formation evidenced by the areas of irregular rarefaction. The examination of the left knee shows very little change in the articular surfaces, but does show multiple areas of rarefaction and increased density adjacent to the joint surfaces possibly due to multiple gumma formation. There is a large cyst-like area in the inner aspect of the lower end of the femur probably due to osteitis fibrosa cystica (Figs. 21 and 22).

Legs: The tibiae showed evidence of diaphysitis, the changes being irregular areas of rarefaction and increased density with some widening of the shaft (Figs. 23 and 24). The left tibia had the typical textbook periosteal gumma. We have termed this lesion localized



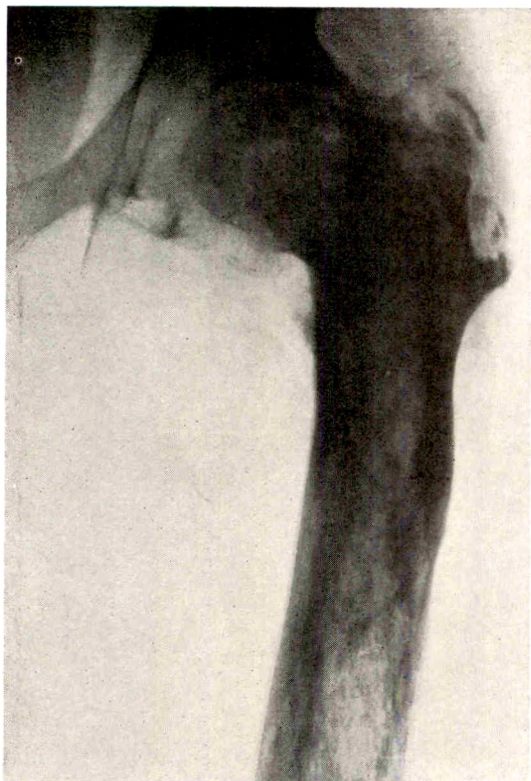


FIG. 16.

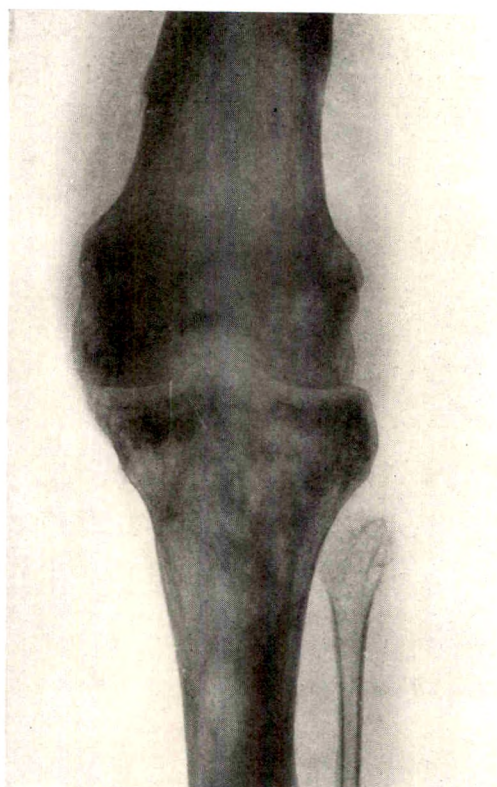


FIG. 17. Anteroposterior view.

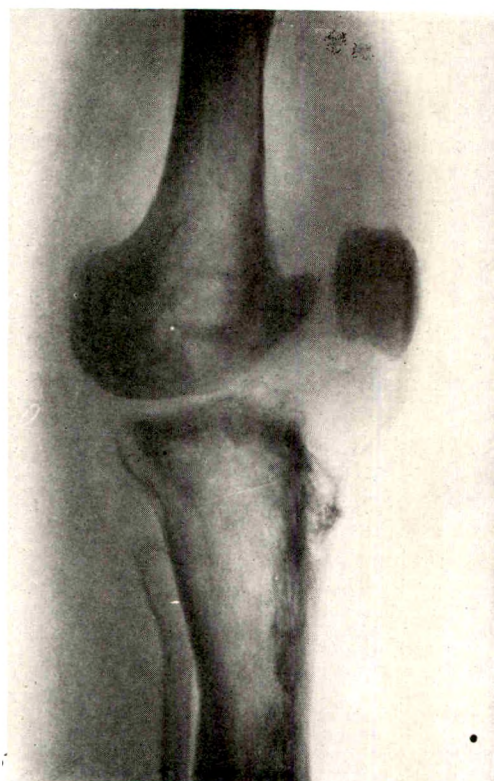


FIG. 18. Lateral view before treatment.

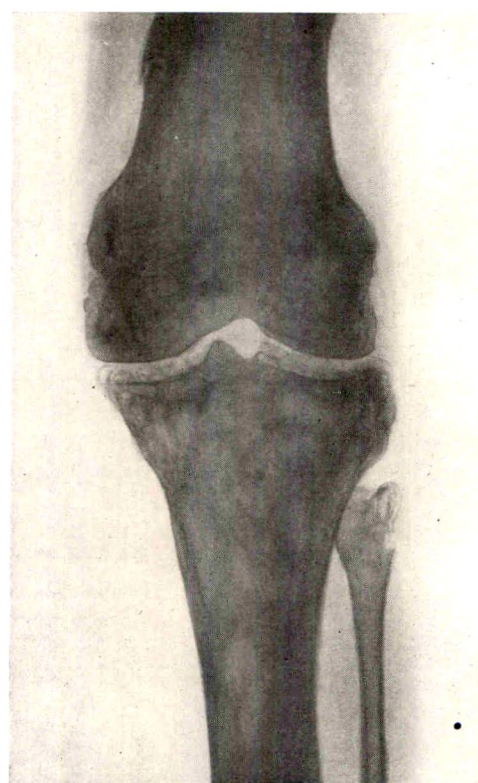


FIG. 19. Anteroposterior view after treatment.





FIG. 20. Lateral view after treatment.

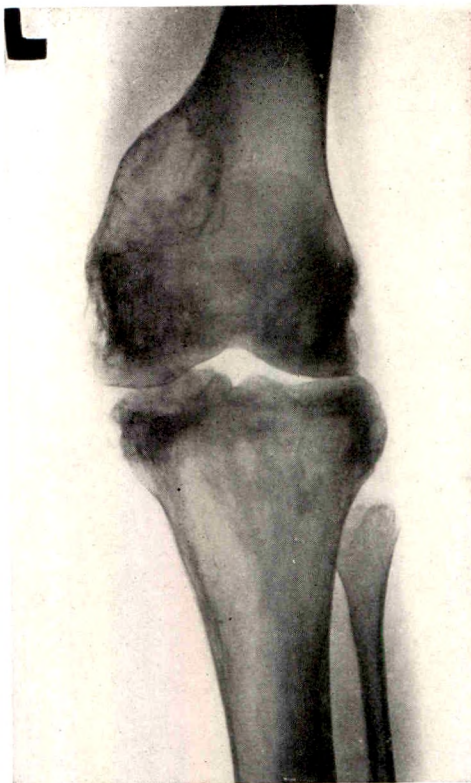


FIG. 21. Anteroposterior view.

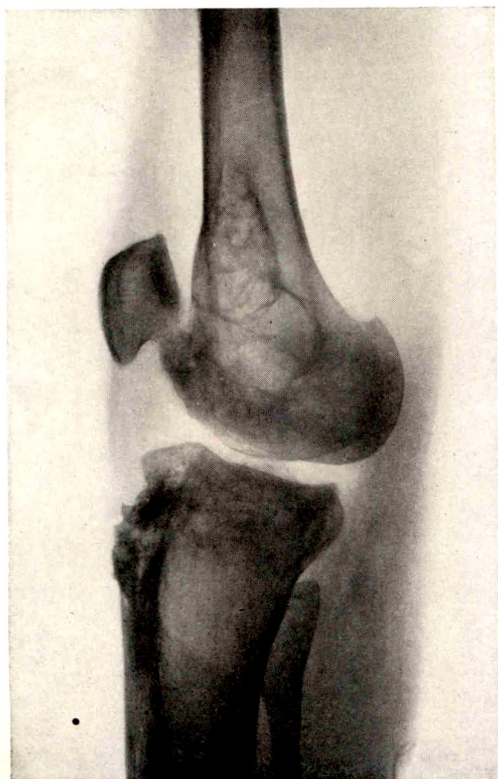


FIG. 22. Lateral view.

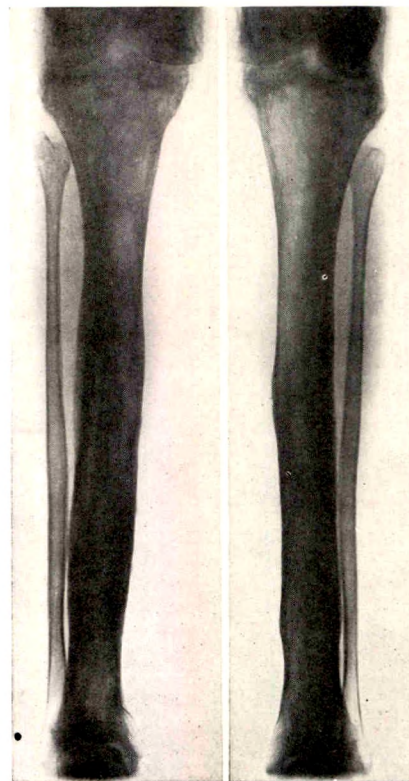


FIG. 23. Anteroposterior view of both legs.





FIG. 24. Lateral view of right leg.

diaphysitis as all the changes are in the cortex, there being little if any periosteal change (Fig. 25).

Feet: Negative.

*Treatment.* Nov. 9 to Dec. 16. Seven injections of potassium bismuth tartrate, a total of 1 gram. At the same time he received daily intravenous injections of sodium iodide, most of the time the maximum dose of 100 c.c. of a 10 per cent solution being employed.

Dec. 17 to Mar. 10, 1928. He received 12 intravenous injections of neoarsphenamine—an average of 0.6 gm. per dose.

Mar. 17 to May 25. He received 10 weekly injections of potassium bismuth tartrate, a total of 1.8 gm.

May 28 to Aug. 4. He received 8 intravenous injections of neoarsphenamine, averaging 0.45 gm.

Aug. 11 to Oct. 17. He received 10 injections of potassium bismuth tartrate—a total of 1.8 gm. Throughout at intervals he has also taken potassium iodide by mouth up to the present time.

*Progress.* Dec. 24, 1927. There has been a gain in weight of 18 lbs. and the spleen and liver are much reduced in size. Cutaneous lesions are 50 per cent involuted.

Jan. 21, 1928. In excellent condition, with a total gain of 30 lbs.

Feb. 28, 1928. Surgical consultation gave the opinion that the osteomyelitis had a marked pyogenic factor and recommended curettement of the cavity, which was done.

Roentgen Examination. There was considerable improvement in the appearance of all the bones previously examined.

May 28, 1928. Braces have been fitted.

*Re-examination.* Aug. 3, 1928. Dr. D. M. Pillsbury.

There are no subjective complaints, the appetite is excellent, bowels regular and no abdominal distress. Weight is 106 lbs. (59" tall), a gain over a year ago, but a loss from his weight in January of 14 lbs. His mental activity has been confined to reading the daily

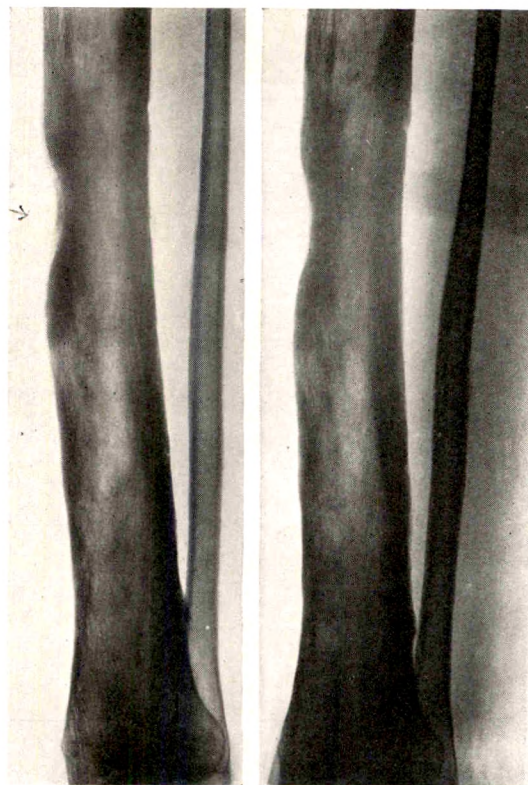


FIG. 25. The illustration on the left shows the lesion before treatment and the one on the right after treatment.



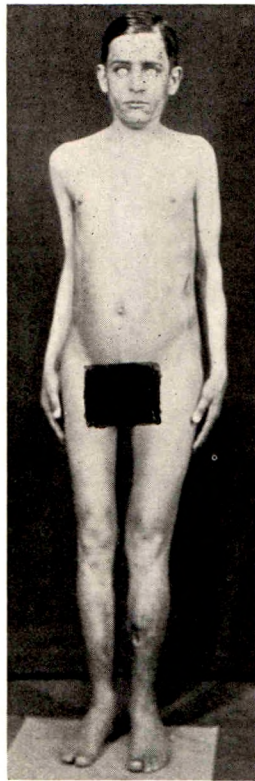


Fig. 26. Photograph of patient. The gumma on the left leg can be seen easily. Patient looks like a boy instead of a man.

paper. He is much more alert than formerly. He regrets his inability to continue school. His reactions are fairly quick, gesticulates freely, and speech comes readily, in fair grammatical construction. His exercise has been confined to walking four or five miles a day and his remaining diversions now include congregation with other individuals.

The pupils react to light and accommodation. There is a slight cloudiness over the right cornea. Ears are negative. Marked cavitation of the teeth is evident. Nose and throat are grossly negative.

There is a loud systolic murmur heard best over the aortic area with no widening of the aortic arch. There is a slight left ventricular enlargement. The lungs are negative but the chest is thickened in the anteroposterior diameter. The liver varies from 3 to 5 fingers' breadth below the costal margin. The spleen is still large, the dullness measuring approximately 10 by 20 cm.

There is no bony tenderness at any point.

The shoulder girdle is negative. There are prominent cranial bosses. There is some enlargement of the upper left humerus. The left elbow and forearm appear normal. There is complete healing of the former ulcer at the right elbow. The joint has a range of movement of about 20 degrees and there is marked crepitus present. The knees are approximately equal in size with no apparent enlargement or pretermobility. There is marked thickening of the right tibia with moderate anterior bowing. There is an ulcer over the left tibia approximately 2 cm. in diameter but free from any inflammatory reaction.

Neurologically, the patient is normal. There is no malarticulation and the patient can retain seven digits by memory.

*Roentgen Examination:*

Head: The bones of the vault are less dense.

Right lower jaw: The area of osteomyelitis has entirely healed (Fig. 8).

Left shoulder: Very little change in appearance.

Right elbow: Very little change in appearance.

Left Elbow: Examination, Feb., 1928, showed considerable improvement in appearance. The periosteal proliferation has disappeared. The shaft of the ulna is smaller and the area of disuse has entirely disappeared (Fig. 12). The last examination, August, 1928, shows an almost normal appearance of the bone (Fig. 13).

Hips and pelvis: Both hips have improved in appearance. The joint surfaces are intact. The right hip still shows advanced hypertrophic changes, probably at the points of attachment of the capsule (Fig. 15).

Right knee: There has been marked improvement in appearance. Most of the periarticular swelling has disappeared, leaving only the hypertrophic changes which will probably remain. The appearance of the bone lesions in the femur and tibia show some healing indicated by the increased density of the bone surrounding the areas of rarefaction (Figs. 19 and 20).

Tibia: There has been considerable improvement in the appearance.

*Subsequent History.* On Oct. 12, 1928, the patient was re-admitted to the hospital in a markedly weakened condition. Prior to admission he had two severe hemorrhages by mouth, with black vomitus, and displayed a

marked yellowish pallor. The patient complained of thirst and inability to get enough air. A diagnosis of ruptured esophageal varices was made. His blood count was: Hemoglobin 14 per cent; red blood cells, 1,300,000; white blood cells, 13,700, with 81 per cent polymorphonuclears. There was likewise distinct anisocytosis and poikilocytosis. Following this, the patient had several transfusions and a paracentesis for an abdominal ascites. He was put on an Anderson diet and liver diet, also received novasural and sodium iodide. The blood count improved rapidly and his spleen was removed at operation. His surgical recovery was uneventful and by March he returned to the out-patient department for further treatment. He has since been given 20 weekly injections of bismarsen for a total amount of 3.9 grams. His last Kolmer Wassermann test was still strongly positive; his blood count on July 9, 1929, showed: Hemoglobin 90 per cent; red blood cells, 5,100,000; white blood cells, 7,100; polymorphonuclears, 67 per cent; lymphocytes, 27 per cent; large mononuclears, 4 per cent; eosinophiles, 2 per cent. His present weight is 106 pounds, while his general physical condition approximates that of a year ago.

#### ADDITIONAL CASES

Four additional reports from the literature are of interest in conjunction with our case. Spence and Tittle<sup>69</sup> reported the case of a white boy of fifteen who gave a history of blood vomiting followed by an increase in the size of his abdomen. Eight successive tapplings were done. The spleen was not markedly enlarged but there was a severe secondary anemia with a hemoglobin of 38 per cent and a red count of 2,430,000. The joints were sore and painful and the general picture was one of marked malnutrition. There was an ulcer of the forehead and one at the sterno-clavicular junction. The elbow was ankylosed and the fingers swollen.

Spackman<sup>68</sup> in a series of 10 cases of late heredosyphilis described a boy of sixteen, small in stature, with an abdomen distended with fluid. Both the liver and spleen were greatly enlarged.

Nobécourt et al.<sup>52</sup> report a case of congenital syphilis with an autopsy report of the findings.

The patient had an enlarged liver and involvement of a number of bones.

Acuña and Casaubon<sup>2</sup> reported the case of a boy of sixteen who had a chronic peritonitis associated with a recurring ascites. There were likewise skin and bone lesions.

#### DISCUSSION OF THE ROENTGEN FINDINGS

Almost every type of osseous syphilis that can occur was present in the case reported above. Dunham<sup>22</sup> has called attention to the infrequency of involvement of the bones of the skull. She reported 2 cases observed in 100 cases of congenital syphilis studied by her. We have observed this finding more frequently, and wish to stress the importance of the roentgen examination. Osseous syphilis may be present without giving any clinical manifestations. Menninger<sup>47</sup> concurs in this opinion. He describes the roentgen findings as osteoporosis. We believe that the most frequent finding in the late cases is that of condensing osteitis (Figs. 2, 3, and 7). A combination of osteoporosis and condensing osteitis seems to be found more frequently in the early cases (Fig. 1). The appearance of the bones of the vault in prenatal syphilis may sometimes closely resemble Paget's disease and one should be careful to keep this in mind. The tendency of the bone to form islands of increased density in Paget's disease should help to differentiate the two processes.

The occurrence of fibrocystic disease in the humerus and femur in our case (Figs. 9, 21 and 22) is very interesting in view of the fact that numerous authors, including Stoloff, Pommer and Looser, Ironside, Barrie, and Scott,<sup>66</sup> have attempted to show that fibrocystic disease or von Recklinghausen's disease in at least some cases is due to prenatal syphilis.

The joint lesions in our case show at least two stages. The types seen in the knees (Figs. 17 and 18) probably represent the form described by Clutton, namely, the bilateral painless hydrops due to inflammatory changes in the synovial membrane.



These changes were marked in both knees, especially the right. The changes found in the right hip (Fig. 16) simulate those described by von Gies.<sup>83</sup> The appearance of the joint suggests an early Charcot's joint, but we were unable to demonstrate any central nervous lesion. We think that the changes can be explained by the fact that the gummatous process in the upper end of the femur had extended to the joint. The extensive involvement of the neck of the femur has caused weakening of the bone with resulting coxa vera.

The changes occurring in the bones, which we have termed diaphysitis, are very similar to those seen in any *low grade osteomyelitis*. It has been interesting to note the marked degree of the changes in the tibia which more or less follows the dictum of Fournier who said, "Syphilis loves the tibia."

We have shown a number of illustrations demonstrating what we believe is the effect of treatment on the bone lesions. We are aware that it is believed by a number of observers that the bone lesions of syphilis may disappear without any treatment. Lindsey et al.<sup>43</sup> state the following: "We frequently have seen typical congenital luetics who upon admission to the clinic showed definite marked and extensive periostitis and who upon re-examination at a later date and, without having had any treatment are reported from the x-ray department as having no roentgen ray evidence of bone lesion and this in spite of cutaneous and other lesions present." We have not had this experience but we believe that it may occur, especially when it is kept in mind that bone lesions are supposed to be due to the local presence of the spiro-

chetes or their toxins, and frequently, according to Harrison<sup>60</sup> and others, follow trauma. We cannot agree with Lindsey et al., that the lesions of late prenatal syphilis are almost never influenced by treatment. We have a number of cases similar to the one reported here that would support the premise that after treatment the bones tend to return to normal, and may actually form normal trabeculation. The periosteal changes disappear, the small areas of rarefaction are replaced by normal trabeculation. If the area of diseased density is large, it becomes surrounded by a zone of increased density, which gradually tends to replace the diseased area, and this area of increased density is in turn replaced by normal trabeculation. The sequestra are apparently absorbed as they disappear (Fig. 8). The joint surfaces seem to heal without new bone formation. When the peripheral bone is destroyed by gumma formation it does not fill in with normal bone after treatment. The scar always remains (Fig. 25).

#### SUMMARY

1. An unusual case of tardive heredosyphilis is reported. The patient had almost every possible type of bone involvement found in syphilis, all of which responded to treatment. The cutaneous manifestations, and the involvement of the liver and spleen were interesting complications.
2. An attempt is made to describe the pathologic and roentgenologic appearances in heredosyphilis and correlate the findings.
3. The patient responded to antiluetic therapy and the change produced in the bones is described.

#### REFERENCES

1. ABT, I. A. Syphilis hereditaria tarda. *Wisconsin M. J.*, 1903-1904, 2, 539-546.
2. ACUNA, M., and CASAUBON, A. Peritonite exsudative chronique par syphilis héréditaire. *Arch. de méd. d. enf.*, 1922, 25, 257-267.
3. ADDISON, O. Syphilitic diseases of joints and bones in children. *West Lond. M. J.*, 1913, 18, 85-91.
4. ANTONIN, P. La syphilis héréditaire tardive des os longs. *Marseille-méd.*, 1922, 59, 164-167.
5. APERT, E. Syphilis héréditaire tardive. *Bull. Soc. anat. de Par.*, 1895, 70, 645.
6. BARRIE, G. Fibrocystic and cystic lesions in bones. *Ann. Surg.*, 1918, 67, 354-363.
7. BARTON, J. K. The Pathology and Treatment

- of Syphilis, Chancroid Ulcers, and their Complications. Fannin & Co., Dublin, 1868.
8. HILL, BERKELEY. Syphilis and Local Contagious Disorders. J. Walton, Lond., 1868.
  9. BERTIN, R.-J.-H. Traité de la maladie vénérienne, chez les enfans nouveau-nés, les femmes enceintes et les nourrices. Gabon, Paris, 1810.
  10. BAETJER, F. H., and WATERS, C. A. Injuries and Diseases of the Bones and Joints. Paul B. Hoeber, New York, 1921.
  11. BOUCHUT, E. Traité pratique des maladies des enfans nouveau-nés, des enfans à la mamelle et de la seconde enfance. Fourth edition. J.-B. Baillière & fils, Paris, 1861. Quoted by Barton, Hill and Diday.
  12. BOWMAN, G. W. Syphilitic osteochondritis. *Urol. & Cutan. Rev.*, 1923, 27, 273-277.
  13. BROCA, A. Syphilis héréditaire des os et articulations. *Rev. prat. d'obst. et de paediat.*, 1913, 26, 1; 33; 65; 97; 129.
  14. CHURCHMAN, J. W. Luetic bursopathy of Verneuil. *Am. J. M. Sc.*, 1909, 138, 371-396.
  15. CLUTTON, H. H. Symmetrical synovitis of the knee in hereditary syphilis. *Lancet*, 1886, 1, 391-393.
  16. CORNIL, A.-V. Syphilis. Translation by Simes and White. H. C. Lea's Son & Co., Philadelphia, 1878.
  17. COUES, W. P. Luetic bursopathy of Verneuil; report of a case of the congenital type. *Boston M. & S. J.*, 1915, 173, 18-20.
  18. CUFF, A. A case of congenital syphilis with curious bone lesions. *Quart. J. Med.*, 1895, 4, 144.
  19. DENNIE, C. C. Syphilis. Harper & Brothers, New York, 1928.
  20. DIDAY, C.-J., P.-E. Treatise on Syphilis in New-Born Children and Infants at the Breast. Trans. by Whitley; notes by Sturgis. Wm. Wood, New York, 1883.
  21. DITTRICH, E. W. Two cases of syphilis hereditaria tarda. *Post Graduate, N. Y.*, 1909, 24, 356-359.
  22. DUNHAM, E. C. Gummatous osteoperiostitis of the skull in congenital syphilis. *Am. J. Dis. Child.*, 1925, 30, 690-699.
  23. FEULARD, H. Syphilis héréditaire. *Ann. de dermat. et syph.*, 1895, 6, 219.
  24. FITZWILLIAMS, D. C. L. Syphilitic affections of bones met with in childhood. *Brit. J. Child. Dis.*, 1912, 9, 97-111.
  25. FOURNIER, A. Quoted by Stokes and others.
  26. FRAENKEL, A. Ein Fall von Lues hereditaria, mit besonderer Bethheiligung der Knochen und der Leber. *Verhandl. d. Cong. f. innere Med.*, 1897, 15, 497-500.
  27. GAUCHER. Les ostéopathies de la syphilis héréditaire tertiaire. *Rev. gén. de clin. et de thérap.*, 1911, 25, 627-629.
  28. GAUCHER. Les ostéites suppurées et les osteoarthrites de l'hérédosyphilis tertiaire. *Ann. d. mal. vén.*, 1906, 1, 3-21.
  29. GAUCHER and GIROUX. Hérédosyphilis tertiaire avec ulcération de la jambe gauche. *Bull. Soc. franc. de dermat. et syph.*, 1908, 19, 336.
  30. HERXHEIMER, G. Ueber die pathologische Anatomie der kongenitalen Lues. *Med. Klin.*, 1907, 3, 1561-1564.
  - 30a. HILL, BERKELEY. See Ref. 8.
  31. HOCHSINGER, C. Studien über die hereditäre Syphilis. Leipzig u. Wien, 1898; 1904.
  32. HUTCHINSON, J. On cases of inherited syphilis in adults with exceptional features. *Poly-clinic, Lond.*, 1900, 2, 287-295.
  33. IRONSIDE. Von Recklinghausen's disease and congenital syphilis. *Brit. J. Vener. Dis.*, 1926, 3, 267.
  34. JONES, R., and LOVETT, R. W. Orthopedic Surgery. Wm. Wood and Co., New York, 1923, pp. 293 and 294.
  35. KARSNER, H. F. Presentation of a pathological specimen. *Proc. Path. Soc. Phila.*, 1910, 13, 64.
  36. KIENBÖCK. *Wien med. Wchnschr.*, 1926, 76, 1035.
  37. LANCERAUX, E. Quoted by Barton and Hill.
  38. LANE, J. E. Symmetrical synovitis of the knee in congenital syphilis (Clutton's joints). *Am. J. Syphilis*, 1922, 6, 611-615.
  39. LANE, J. E. Syphilitic bursitis (luetie bursopathy of Verneuil). *J. Am. M. Ass.*, 1924, 82, 852-854.
  40. LAROCHE, G., and BARTHES. Un cas pléonostéose chez un hérédosyphilitique. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1927, 51, 459-464.
  41. LÉVY-BING, A., and DUROUX, L. Un cas d'hyperostoses syphilitiques héréditaires des os longs. *Ann. d. mal. vén.*, 1913, 8, 116-124.
  42. LÉVY-FRANCKEL, A. Ostéo-périostite suppurée de l'hérédosyphilis tertiaire. *Ann. d. mal. vén.*, 1906, 1, 122.
  43. LINDSEY, J. W., RICE, E. C., and SELINGER, M. A. Bone changes in congenital syphilis. *Am. J. Syph.*, 1927, 11, 118-126.
  44. MACCALLUM, W. G. Text Book of Pathology. Saunders, Philadelphia, 1928, pp. 741-744.
  45. MANN, H. C. Some notes on hereditary syphilis. *Guy's Hosp. Gaz.*, 1912, 26, 144-147.
  46. MENARD, V. LE MOINE, F., and PÉNARD, I. Contribution à l'étude clinique et radiographique de la syphilis héréditaire des os longs. *Gaz. d. hôp. Par.*, 1908, 81, 567-574. •

47. MENNINGER, KARL A. Heredosyphilitic cranial osteoporosis. *Radiology*, 1925, 4, 480-491.
48. MENNINGER, W. C. Congenital syphilis and gigantism. *Endocrinology*, 1926, 10, 405-412.
49. MEURISSE, P. Sur un cas d'hérédosyphilis tardive. *Ann. d. mal. vén.*, 1927, 22, 820-822.
50. MORGAN, J. H. A discussion on congenital syphilitic manifestations in bones and joints. *Brit. M. J.*, 1895, 2, 697.
51. MOUCHET and MEAUX-SAINT-MARC. Sur les formes anormales de l'hérédosyphilis tardive des os longues. *Bull. et mém. Soc. de chir. de Par.*, 1913, 39, 1347-1358.
52. NOBÉCOURT, P., PICHON, E., and PRÉTET, H. Congenital syphilis of the bones and liver in a boy of twelve years. *Arch. de méd. d. enf.*, 1927, 30, 164-171.
53. PARROT, J. Sur une pseudo-paralysie causée par une alteration due systeme osseux, chez les nouveau-resalteints de syphilis héréditaire. *Arch. de physiol. norm. et path.*, 1871-1872, 4, 314-333.
54. PARROT, J. *Soc. anat.*, 1873; *Mem. arch. physiol.*, 1876.
55. PARKINSON, J. P. Late effects of inherited syphilis. *Brit. J. Child. Dis.*, 1908, 5, 87-90.
56. PENDERGRASS, E. P., and BROMER, R. S. Congenital bone syphilis. *Am. J. Roentgenol. & Rad. Therapy*, 1929, 22, 1-21.
57. PINARD, M. Hérédosyphilis "dite" tardive. *Bull. Soc. franç. de dermat. et de syph.*, 1921, 28, 279-281.
58. POMMER and LOOSER. Quoted by Stoloff.
59. POST, A. A case of late congenital syphilis. *Med. & Surg. Rep. City Hosp.*, 1898, 9, 233.
60. RANVIER, L. Syphilis congenitale. *Compt. rend. Soc. de biol.*, 1865, 1, 39.
61. ROEDERER, M. J. Ostéomyélite hérédosyphilitique. *Presse méd.*, 1923, 31, 727.
62. ROSEN, N. R. Quoted by Péhu, M., and Enselle, J. Sur la syphilis congénitale des os longs dans la première enfance. *Rev. franç. de pediat.*, 1925, 1, 261-269. Also quoted by Hochsinger.
63. ROSENSTEIN, R. Quoted by Taylor, R. W. Syphilitic Lesions of the Osseous System in Infants and Young Children. Wm. Wood & Co., New York, 1875.
64. ROUILLARD, J., and CALMELS, J. Hérédosyphilis tardive. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1926, 50, 900-905.
65. SAUNDERS, A. A case of syphilitic periostitis. *West Lond. M. J.*, 1910, 15, 43.
66. SCOTT, C. R. Bone lesions of congenital syphilis. *Am. J. Dis. Child.*, 1924, 28, 38-50.
67. SEQUEIRA, J. H. A clinical lecture on some late manifestations of inherited syphilis. *Lancet*, 1914, 1, 11-13.
68. SPACKMAN, E. D. Observations of ten cases of delayed congenital syphilis. *Lancet*, 1922, 2, 65-66.
69. SPENCE, R. C., and TITTLE, L. C. A case of congenital syphilis with ascites. *South. M. J.*, 1923, 16, 512-513.
70. STADLER, E. Ueber Knochenerkrankung bei Lues hereditaria tarda. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1907, 11, 82-85.
71. STEINMETZ. Un cas rare de syphilis héréditaire osseuse. *Presse méd.*, 1923, 31, 727.
72. STOKES, J. H. Modern Clinical Syphilology. Saunders, Philadelphia, 1926.
73. STOLOFF, E. G. Bone cavities. *Am. J. Roentgenol. & Rad. Therapy*, 1927, 18, 26-42.
74. SUTHERLAND, G. F., and MITCHELL, J. H. Effects of treatment on bone lesions in congenital syphilis. *J. Am. M. Ass.*, 1923, 81, 1752-1757.
75. SUTHERLAND, G. F. Some late manifestations of hereditary syphilis. *Internat. Clin.*, 1895, 4, 235.
76. TRIMBLE, W. B. Tardy hereditary lues (two cases). *J. Cutan. Dis. inc. Syph.*, 1912, 30, 349.
77. TSCHERNIAWAKI, W. A. Ueber einen Fall von Osteochondritis und Dactylitis luetica hereditaria. *Ztschr. f. orthop. Chir.*, 1906, 16, 306-321.
78. TUBBY, A. H. The bone and joint lesions in hereditary syphilis. *Brit. J. Child. Dis.*, 1908, 5, 49-52.
79. TURNBULL, HERBERT M. Recognition of congenital syphilitic inflammation of the long bones. Article written by Eardley Holland in Reports and Public Health and Medical Subjects No. 7; Ministry of Health, H. M. Stationery Office, 1922; Also *Lancet*, 1922, 1, 1239-1241.
80. VALLEIX. *Bull. Soc. anat. de Par.*, 1834, 9, 169. Quoted by Taylor, see Ref. 63.
81. VILLEMIN. L'ostéite syphilis héréditaire. *Rev. gen. de clin. et de therap.*, 1908, 22, 97-99.
82. VIRCHOW. Quoted by Wegner.
83. VON GIES. Quoted by Barrie.
84. WALDEYER and KOBNER. Beitrage zur Kenntnis der hereditäre Knochen Syphilis. *Virchow's Arch. f. path. Anat. (etc.)*, 1872, 55, 367.
85. WARE, M. W. X-ray studies of the bones in congenital syphilis. *Tr. VIth Internat. Derm. Congress, N. Y.*, 1907, 2, 801.
86. WEBER, F. P. A note on congenital syphilitic osteitis deformans. *Brit. J. Child. Dis.*, 1908, 5, 83-86.
87. WEGNER, G. Ueber hereditäre Knochensyphilis bei jungen Kindern. *Virchow's Arch. f. path. Anat. (etc.)*, 1870, 50, 305-322.
88. YAMPOLSKY, J. Charcot's joint associated with congenital syphilis. *J. Med. Ass. Georgia*, 1923, 12, 457-461.

# ROENTGENOLOGICALLY DEMONSTRABLE CHANGES IN BONE IN GAUCHER'S DISEASE

## REPORT OF A CASE

By B. R. KIRKLIN, M.D., and HANS W. HEFKE, M.D.

*Section on Roentgenology, The Mayo Clinic, Fellow in Radiology, The Mayo Foundation*

ROCHESTER, MINNESOTA

GAUCHER'S disease belongs to the diseases that are accompanied by more or less marked splenomegaly. The differential diagnosis of Banti's disease, atypical leukemia, and other diseases in which spleens are enlarged, is often difficult. Since Pick, in 1922, described the so-called osseous form of Gaucher's disease, many such patients have been examined for lesions of the bone which might be demonstrated roentgenologically. Fischer, in 1928, reviewed from the literature 15 reports of cases of lesions of the bone in Gaucher's disease and added 2 of his own. We are reviewing 12 other cases from the literature (vonMueller, Santee and Lindau) and are reporting one case from The Mayo Clinic.

Gaucher's disease is considered by most writers on the subject to be a disease of disturbed lipid metabolism rather than of neoplastic origin. Kerasin, a lipid substance, can be demonstrated in Gaucher's cells. These cells belong to the reticulo-endothelial system and become large and clear when kerasin has been deposited in them. The spleen, liver, lymph nodes and the medulla of the bones have been shown to contain these cells. Their invasion of the bone marrow leads to decalcification of the bone and localized areas of destruction which, if large enough, may be demonstrated by the roentgen ray. Junghagen stated that one may expect changes as follows: (1) marked general osteoporosis; (2) porous and trabeculated spongiosa; (3) destruction of the spongiosa either in small or large areas; (4) thinning of the cortex and widening of the long bones, particularly the lower end of the femur, and (5) compression of diseased bones, particularly the

head of the femur, by the weight of the body.

In the 17 cases reviewed by Fischer, there were changes in the head of the femur in 7 cases, in the vertebrae in 6, in the lower part of the femur in 6, in the tibia in 3, and in the humerus in one case. Fischer believes that widening of the lower end of the femur, producing what he terms a bottle shape, is one of the first changes and occurs before any areas of destruction can be demonstrated in the skeleton.

In the cases reviewed by us the bones were involved as follows: vertebrae in 2 cases; head of femur and pelvis in 6; lower part of the femur in 5; tibia in 3; humerus in one case, and skull in one. In vonMueller's case there was a definite destructive lesion in the hip joint and in the head of the femur, similar to that caused by tuberculosis. The same picture was found in Santee's case, and again the appearance of tuberculosis of the hip was mentioned. Lindau's case, apparently in a rather advanced stage of the disease, showed many roentgenologic signs of involvement of bone, including decalcification of the long bones with areas of destruction of varying size and compression of the vertebrae. Lindau also emphasized the resemblance of the lesions to lesions of tuberculosis. In 4 cases of Gaucher's disease, Mühsam noted only one case in which there was widening of the lower end of the femur. In one of the 2 cases described by Milch and Pomeranz, there was absorption in the skull and long bones, areas of destruction in the humerus, involvement of the hips and head of the femur, and widening of the lower ends of the femurs; in the other case only medullary absorption and widening of one tibia were pres-



ent. Walt, Rosenthal and Oppenheimer found demonstrable lesions of bone in roentgenograms in 6 of 8 cases. They found the most common early change to be fusiform expansion of the lower third of the femur. In their opinion, gross skeletal changes, such as bending and pathologic fracture, are rare; only one example in the 8 cases was noted. In one case a pathologic fracture of the spine, and in 3 cases pathologic fracture of long bones had occurred; the entire skeleton except the skull showed rarefaction. In 2 cases the femurs and tibias were involved, and in one of them the pelvis and fibula also. In 3 cases the head of the femur was mushroom-shape and the neck was shortened. Bilateral fusiform expansion of the lower third of the femur was noted in 4 of the 6 cases; in 2 of them it was the only demonstrable roentgen sign and was considered to be an early indication of the disease, as Fischer had previously asserted.

#### CASE REPORT

Our patient, a Jewess, aged twenty-six, was examined at The Mayo Clinic in September,

1927. As a child she had been sickly. At the age of seven years her spleen had been found to be enlarged. General treatment improved her health somewhat. In 1921, her spleen had been irradiated. She had felt fairly well until 1927, when she noticed definite enlargement of the spleen and increased weakness.

The spleen was found to be very large, reaching the symphysis pubis; the liver was palpable 10 cm. below the costal margin. There were some areas of pigmentation in the face, and fat pads on the nasal margin of the juncture of the cornea and sclera. The hemoglobin was 58 per cent; erythrocytes numbered 3,570,000, and the leucocytes 5,200; the color index was 0.8. The percentage of leucocytes was: lymphocytes 20, large mononuclears 2.0, transitionals 0.5, neutrophils 76.5, and eosinophils 1. The coagulation time was eleven minutes and thirty seconds, and twelve minutes and thirty seconds, respectively, on two occasions. Roentgen examination of the skeleton was not made.

It was decided to give irradiation before operation. Following this, the general condition of the patient improved, and in November, 1927, splenectomy was performed. The spleen was large, firm, pinkish and adherent posteri-

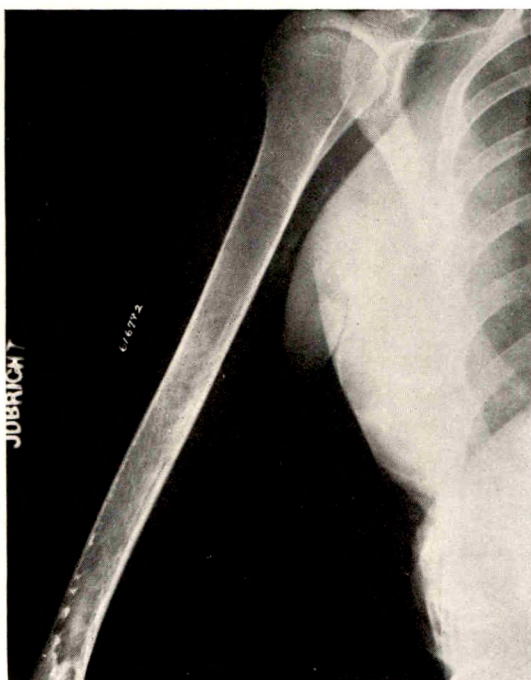


FIG. 1. Changes in bone in Gaucher's disease.

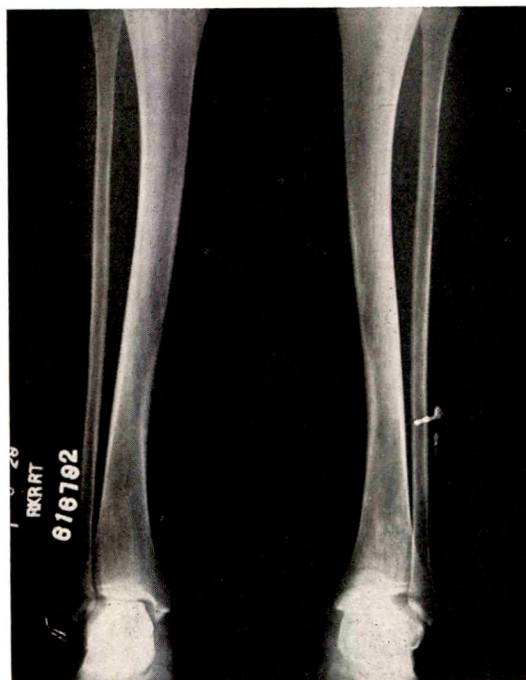


FIG. 2. Changes in bone in Gaucher's disease.



only; the liver was also enlarged, and contained tiny shot-like nodules. The report after microscopic examination was "Gaucher's spleen with marked endothelial proliferation, and

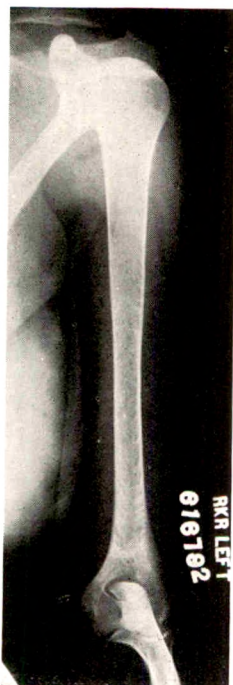


FIG. 3. Changes in bone in Gaucher's disease.

Gaucher's liver with an accumulation of pigment in the cells similar to that found in the spleen." The patient recovered uneventfully from the operation and her health improved considerably afterward. When she visited the Clinic in July, 1929, she had gained 10 pounds. Six months before the visit she had suffered from rather severe pain in the right thigh and leg, which was relieved by heat. Examination did not disclose a mass in the abdomen. Roentgen examination disclosed enlargement of the medulla and thinning of the cortex in the humerus and radius of both arms and of the upper ends of both femurs. The thorax, spine, pelvis and skull appeared to be normal. This case apparently does not belong to the osseous type of Gaucher's disease according to Pick's description. The symptoms referable to the bones appeared late in the course of the disease, the lesions demonstrable by the roentgen ray were not severe nor destructive, and there were no pathologic fractures. The vertebrae apparently were not affected. Only the long bones

showed more or less uniform roentgenologic signs. The most marked change was the general decrease in density, which in many respects might be compared with senile osteoporosis (Fig. 1). The cortex was markedly thinned but did not present any areas of destruction (Fig. 2). The trabeculae of the medulla were not as fine as normally, but rather coarse (Fig. 3). It appeared as if they had been spread apart by a process taking place between them, rather than that they had been destroyed by malignant cells. The changes were seen in the humerus and radius of both arms and in the femurs. The changes were most marked in the shafts of the femurs. The lower ends were somewhat widened (Fischer's sign), as shown in Figure 4.

Considered from a standpoint of differential diagnosis the picture was rather typical of the changes in bone in Gaucher's disease. There was no definite, well circumscribed area of destruction of bone suggestive of metastasis or multiple myeloma. It would be more difficult, however, to distinguish it from marked senile atrophy if the patient were old. Contrary to the ex-



FIG. 4. Changes in bone in Gaucher's disease.

perience of many observers, the roentgenologic picture of the long bones in this case can hardly be attributed to tuberculosis or syphilis.

## REFERENCES

1. FISCHER, A. W. Das Röntgenbild der Knochen, besonders des Femur in der Diagnose des Morbus Gaucher. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, 37, 159-164.
2. JUNGHAGEN, SVEN. Röntgenologische Skelettveränderungen bei Morbus Gaucher. *Acta radiol.*, 1926, 5, 506-516.
3. LINDAU, ARVID. A case of Gaucher's disease. *Acta path. et microbiol. Scand.*, 1928, 5, (Suppl.), 22-23.
4. MILCH, HENRY, and POMERANZ, MAURICE. Bone changes in Gaucher's splenomegaly. *Ann. Surg.*, 1929, 89, 552-560.
5. VON MUELLER, FRIEDRICH. Problems of disease of the joints. *Arch. Int. Med.*, 1927, 40, 399-419.
6. MÜHSAM, RICHARD. Die operative Behandlung des Morbus Gaucher. *Arch. f. klin. Chir.*, 1928, 153, 215-234.
7. PICK, L. Zur pathologischen Anatomie des Morbus Gaucher. *Med. Klin.*, 1922, 18, 1423-1424.
8. SANTEE, H. E. Gaucher's disease. *Ann. Surg.*, 1927, 86, 707-714.
9. WALT, SARA, ROSENTHAL, NATHAN, and OPPENHEIMER, B. S. Gaucher's splenomegaly with special reference to skeletal changes. *J. Am. M. Ass.*, 1929, 92, 637-644.





## SARCOMA OF THE RIB\*

By ROBERT J. REEVES, M.D., and H. H. KASABACH, M.D.

NEW YORK CITY

**P**RI-MARY tumors occurring in the ribs and chest wall are chiefly sarcomata and carcinomata. The diagnosis is usually not made until the appearance of a tumor mass. Persistent pain over a long period is one of the chief symptoms. It is as a rule dull, boring in character, and is not affected by respiration.<sup>2,8</sup> The question of trauma has been emphasized by some writers,<sup>6</sup> but in a number of the cases reported there is no history of injury.

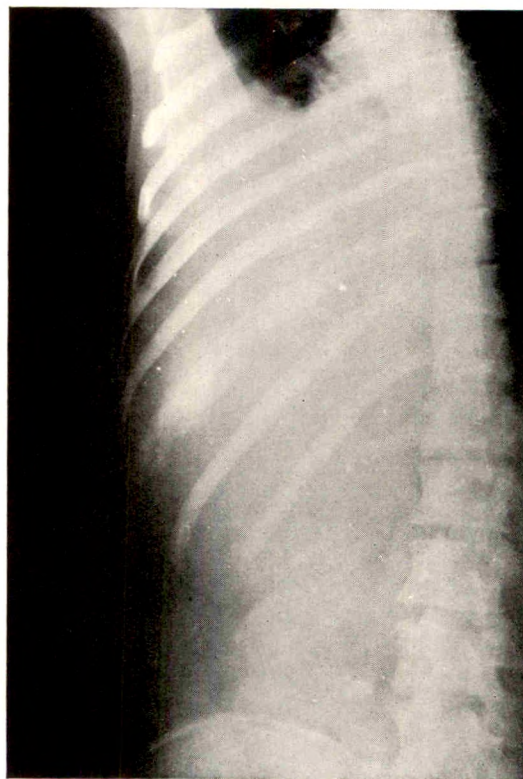
Webber,<sup>8</sup> in 1900, seems to be the first to report a case in which the diagnosis of spindle cell sarcoma was made. Lund,<sup>4</sup> in 1913, presented a thorough review of the literature and analysis of cases reported. His discussion, however, is limited chiefly to the surgical aspect. Molimard,<sup>5</sup> in 1908, found 39 cases in the literature. The most common site of occurrence of the tumor was in the sixth, seventh, and eighth ribs posteriorly, and usually involving more than one rib. The first rib was involved in only 3 cases, the second in 6 cases. The tumor mass, in the majority of cases, expanded outside the chest, and only when it pushed inward did it impinge upon the intercostal nerves and produce pain. Extension of the tumor was found in the parietal, but not in the visceral, pleura.

The roentgen appearance of the tumor in the rib varies from a purely destructive process to a combination of destruction with bone production radiating outward from the rib. The soft tissue tumor can usually be seen extending about the involved ribs.

**CASE I** (Unit No. 76096). A white girl, aged eighteen, was admitted to the Medical Service of the Presbyterian Hospital, Nov. 8, 1928, complaining of pain in the left chest. The latter part of August, two and one-half months previously, after a long swim, she

began to have a dull, constant pain in the lower left side of the chest, aggravated by deep inspiration. Three weeks prior to her admission the diagnosis of pleurisy was made, and she was put to bed. A week later the family physician discovered the presence of fluid in the chest, and presumed she had a tuberculous pleurisy with effusion.

On admission her temperature was 99°F., pulse 84. A film of the chest on Nov. 10, disclosed a dense shadow over the lower half of the left lung field with displacement of the heart which was interpreted as fluid. On Nov. 14, 500 c.c. of blood-tinged fluid was removed. Two more thoracenteses were performed during



**FIG. 1.** Case I. Destruction of the outer portion of the ninth rib with considerable bone production radiating outward from it. The soft tissue tumor mass extends upward to the sixth rib.

\* From the Department of Medicine, Columbia University, and the Roentgen-Ray Department of the Presbyterian Hospital, New York City.



the month of December, at which time 700 and 1000 c.c. of blood-tinged fluid was removed. Guinea pig inoculations failed to disclose tuberculosis.

On Dec. 24, a roentgen examination of the chest wall (Fig. 1) disclosed a destructive and productive process in the left ninth rib at the posterior axillary line, and extending backward for a distance of 5 cm. Small areas of diminished density were scattered throughout the involved area, with irregular, curved, streaky shadows of calcium density in the soft tissues about it. This was interpreted as osteogenic sarcoma.

On Jan. 7, 1929, a rib resection was performed by Dr. Hugh Auchincloss, which disclosed an inoperable tumor involving the ninth rib, and involving the chest wall and pleura. Portions of the eighth, ninth and tenth ribs were removed with part of the mass.

The pathological report was as follows: "Sections taken from the tumor show masses of cells which tend toward radial arrangement around the blood vessels. The cells are large and polyhedral, with fairly uniformly staining chromatin, and very little cytoplasm. Mitotic figures occur, two to three to every high power field. There are other areas in which strands of more hyperchromatic cells are found extending between connective tissue bundles. The marrow spaces of the bones contain large numbers of round cells, but these do not resemble the cells of the tumor. There is no bone production seen." The diagnosis was sarcoma—probably Ewing type.

Roentgen therapy was begun on Jan. 16, 1929. During the following eight months she was given fractional doses of high voltage roentgen rays, applied front and back, over the lower portion of the left chest, with intervals of short rest, totalling about eight erythema doses. Roentgenograms of the chest April 10, showed a striking diminution in the shadow at the left base. A shadow was now noted at the left apex projecting inward from the medial wall, suggesting an extension of the tumor. Re-examinations May 24 and July 25 showed a continued increase in the size of the shadow at the left apex and the development of a new mass projecting from the mediastinum lower down. The latter part of July she began to have fever, gradual loss of weight, and pain in the left shoulder. There

was a definite tanning and scaling of the skin over the area irradiated. Slight ptosis of the left upper eyelid was noticed. The left upper part of the chest was irradiated with some

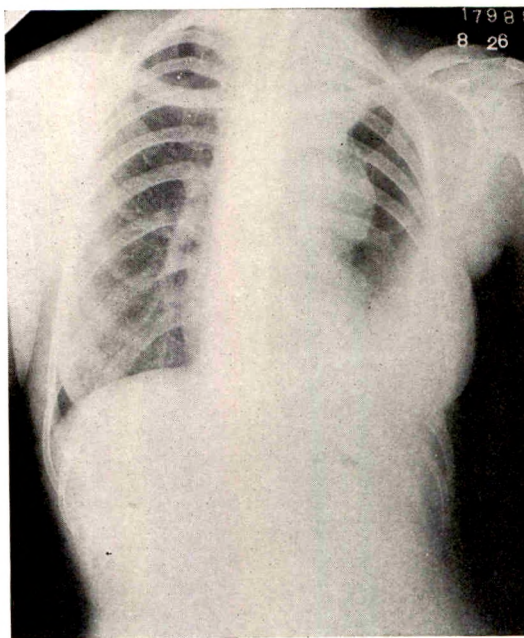


FIG. 2. Case I. Recurrence of the tumor mass about the rib and extension along the mediastinal pleura to the apex of the lung.

regression of the tumor shadow. In the meantime the shadow at the left base began to grow again (Fig. 2).

On Oct. 23, she was given a series of six injections of Coley's toxin, with no appreciable benefit. Pain in the chest became more severe, and the temperature remained high. The last roentgen examination, Nov. 7, showed most of the left lung to be covered by the shadow of the tumor. She became steadily worse and on Nov. 9 died.

Necropsy disclosed a diffuse extension of the malignant process into the pleura, left lung, diaphragm, pericardium and mediastinum. Metastases were found in the right lung and caudate lobe of the liver. The calvarium was not opened.

CASE II (Unit No. 84777). A white boy, aged nineteen, came to the Vanderbilt Clinic, July 18, 1929, complaining of a severe "cold", of four months' duration, and of sharp pain in the right chest. The pain was more severe on deep inspiration, and was more troublesome when



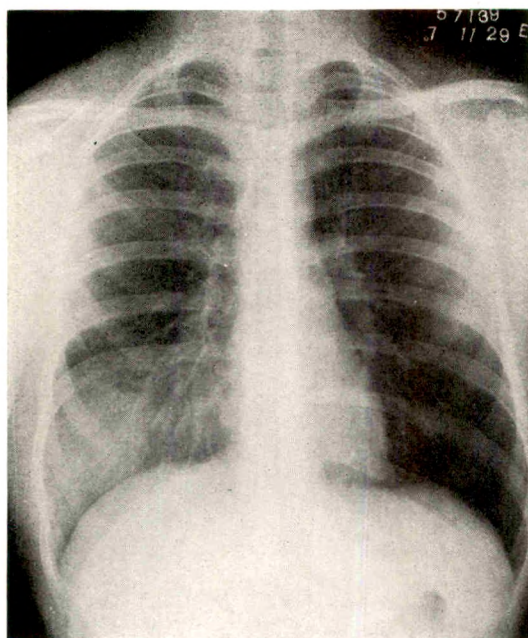


FIG. 3. Case II. Destruction of the posterior portion of the right tenth rib with very little bone production. A rounded tumor mass projecting into the lung or pleural cavity.

lying down. Six weeks prior to admission he noticed a lump below the right scapula, and a constant feeling of numbness over a small area in the right upper quadrant, with occasional dull aching pain about the right infrascapular region. There was no history of injury.

Physical examination disclosed a firm, nodular mass measuring  $13 \times 8$  cm. and 3 cm. in thickness, arising from the region of the ninth, tenth and eleventh ribs near the posterior axillary line on the right side. To the right of the umbilicus was an area of partial anesthesia. The chest was negative except for an area of dullness in the region of the mass. The abdominal reflexes on the right were decidedly less active. Otherwise the physical examination was negative. Roentgen examination of the chest on July 11 (Fig. 3) disclosed a moderately dense, rounded shadow in the right lung field, just above the diaphragm, projecting forward from the posterior wall over the tenth rib. The posterior half of this rib appeared partially destroyed, and there was no evidence of new bone production. The diagnosis was sarcoma of the tenth rib.

On July 18, aspiration of the mass produced nothing but a small amount of bloody fluid.

The intracutaneous tuberculin test was negative. The clinical diagnosis was either tuberculosis or sarcoma, with most of the evidence favoring the latter.

On July 20, a small incision was made over the center of the mass and a portion of it removed.

Microscopic examination showed connective tissue and striated muscle invaded by a tumor composed of small polyhedral cells with large, irregular nuclei. The cells varied as to morphology and size, and had no definite arrangement. Mitotic figures averaged one in every two high power fields. The diagnosis was "sarcoma of the rib."

The growth appeared to be inoperable, and it was decided that a radical excision of the involved rib was not indicated. He was referred to the roentgen therapy department for treatment. Between July 25 and Oct. 13, 1929, he received fractional doses of short wave roentgen rays approximating a total of two erythema doses. Roentgen examination of the chest on Sept. 13 (Fig. 4) showed the mass to have practically disappeared. Although there was no change in the appearance of the tenth rib, the pain was relieved, and he gained weight.

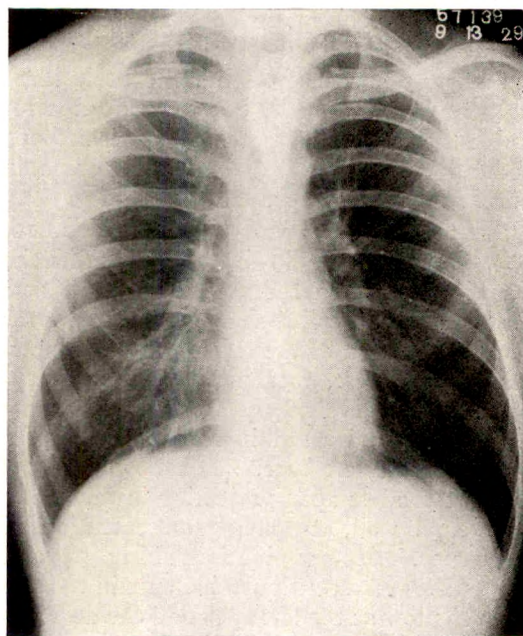


FIG. 4. Case II. Disappearance of the soft tissue tumor after the administration of fractional high voltage therapy.



On Oct. 20, he was re-admitted to the hospital, complaining of chilly sensations of seven weeks' duration, and pain in the right chest. The palpable tumor mass reappeared about the size of an orange. The surrounding soft tissues were tender but not discolored. His temperature was  $103^{\circ}\text{F.}$ , and the pulse rapid. Roentgen examination of the chest on Nov. 26 (Fig. 5) showed no evidence of a tumor mass within the chest, and no evidence of repair of the involved portion of the tenth rib. Roentgen therapy was not considered advisable at this time, but a series of injections of Coley's serum was begun daily, or every other day, until Dec. 2. During this treatment he had severe reactions, the temperature rising as high as  $104^{\circ}\text{F.}$  at times. The mass showed no change in size. On Nov. 21, roentgen therapy was begun, and during the following three weeks he received one and one-half erythema doses over the tumor with no apparent effect. Roentgen examination of the chest on Dec. 24 (Fig. 6) showed most of the right side to be

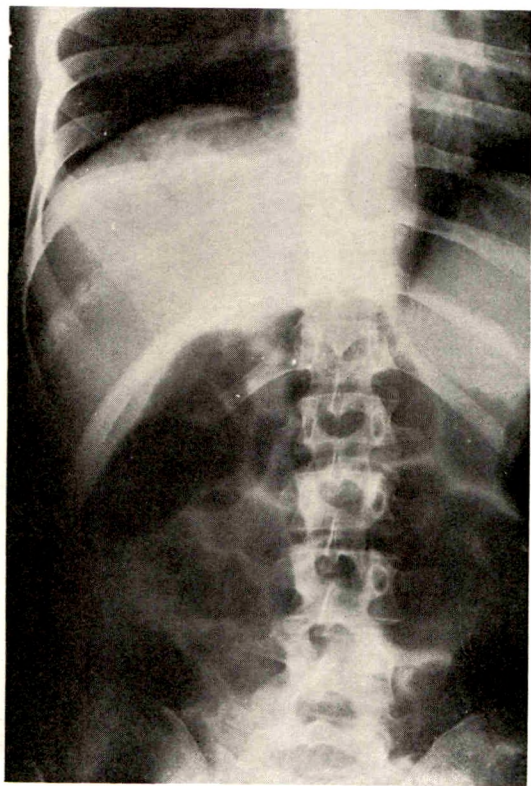


FIG. 5. Case II. No evidence of bone regeneration about the tumor.

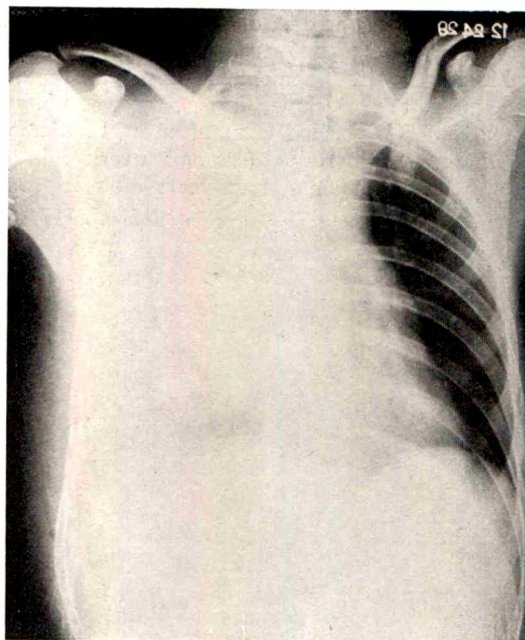


FIG. 6. Case II. Rapid recurrence of the soft tissue tumor during treatment with Coley's serum and a small amount of radiotherapy.

covered with a homogeneous dense shadow, suggesting recurrence of the tumor.

His condition grew rapidly worse, and the tumor mass continued to grow steadily. He was sent to a convalescent home where he died on Feb. 13, 1929.

#### CONCLUSION

Sarcoma of the rib is to be differentiated from tuberculosis, which can be done only with great difficulty because the tumor may be only a destructive process resembling tuberculosis. In young individuals the history of injury, associated with pain should suggest a tumor. Palliative roentgen therapy should be used in all cases as a means of relieving pain and prolonging life.

#### REFERENCES

1. DERUGINSKY, S. Resection of portion of the chest wall and of the diaphragm for primary sarcoma of the pleura. *Ann. Surg.*, 1906, 43, 645-651.
2. GATEWOOD. Sarcoma of the rib. *S. Clin. N. Am.*, 1922, 2, 811-819.
3. HEDBLUM, C. A. Sarcoma of the fourth rib (right); excision by three-stage operation; x-ray treatment. *S. Clin. N. Am.*, 1926, 6, 865-871.

4. LUND, F. B. Sarcoma of the chest wall. *Ann. Surg.*, 1913, 58, 206-217.
5. MOLIMARD, E. Traitement des tumeurs du squelette thoracique. Lyons, 1908, 40 pp.
6. OUTLAND, J. H., and CLENDENNING, L. Sarcomatous proliferation (sarcoma of rib), in a traumatic tumor sixteen years after its first appearance. *J. Am. M. Ass.*, 1915, 65, 1177.
7. REYES, C. Anterior thoractomy for chondrosarcoma of the rib. *J. Philippine Islands M. Ass.*, 1925, 5, 268-269.
8. WEBBER, H. W. A case of sarcoma of the sixth rib in the removal of which the pericardial and left pleural cavities were opened; recovery. *Lancet*, 1900, 2, 1347-1348.





## MENSTRUAL HEADACHES\*

By CHARLES L. MARTIN, M.D.

*Associate Professor of Radiology, Baylor College of Medicine*

DALLAS, TEXAS

**I**N STUDYING the histories of our gynecological cases sent in for radiation therapy, we have found that severe recurrent headache associated with menstruation has appeared many times as one of the major symptoms bringing the patient to a physician. The seriousness of this condition is well illustrated by the following quotation from "Queries and Minor Notes"<sup>30</sup> in a recent issue of the *Journal of the American Medical Association*:

To the Editor:—Can you give me any suggestions concerning the relief of recurrent vomiting and headache during menses? I have a patient, aged 40, regular, with no anatomic basis for trouble, who has had violent "bilious" attacks with every period for 20 years. She is a nullipara, otherwise in excellent health, is not neurotic, and does not magnify her ills. Would any of the desiccated endocrine preparations be indicated? I have tried various migraine remedies, diets, and other usual measures with no relief.

Answer: It is unfortunate that there is no specific remedy for the vomiting and headaches that occur at the time of the menses. Endocrine preparations are nearly always ineffectual. Occasionally, they give temporary relief, but the result may usually be attributed to the effect on the psyche. Attention to the general health and especially the bowels helps some women.

Such a gloomy outlook should intrigue the interest of the various medical specialties, radiology along with the rest.

It is customary to deal first with etiology in discussing a disease, but since we are dealing here with a symptom-complex rather than a disease, the detection of a specific cause offers many difficulties. The perusal of a limited number of case histories suggests the conclusion that a certain group of menstrual headaches results from organic disease, or perhaps from an

overtaxed nervous system; while others coming later in life are due to an approaching menopause. However, one combination of symptoms has occurred frequently enough to indicate the possibility of a specific underlying causative factor. The sufferer begins to have headaches at puberty, the attack usually beginning just before or on the first day of menstruation and lasting one or two days. The pain is in the occipital or frontal region, sometimes appearing behind the eyes or in the temples and is often accompanied by nausea and vomiting of an intractable character. The patient is usually confined to bed for a few days each month, and tries all sorts of headache remedies, often resorting to opiates before real relief is obtained. Sinuses are drained, teeth removed, nasal septums straightened, appendices removed, uterine suspensions performed, and other measures too numerous to mention resorted to, with little or no success. There is in most cases a complete absence of headaches during pregnancy, with a reappearance of the syndrome as soon as the periods are re-established. Between the ages of thirty and forty the attacks become more severe, and one or more headaches of lesser severity appear between the menstrual periods. The patient spends about half of her time in bed and may lose weight because of the repeated attacks of vomiting. However, these attacks often end suddenly with an instantaneous return of a good appetite, so that any temporary weight loss is quickly compensated for. As the menopause is passed, the headaches may disappear or be markedly improved, although in some instances they show no change.

Many explanations of this syndrome have been advanced. Some suggest that

\* Read at the Thirtieth Annual Meeting, American Roentgen Ray Society, New York City, Sept. 17-20, 1929.

the condition is a true migraine, although this helps matters very little, since the nature of migraine is so poorly understood. It is true that migrainous attacks recur at regular intervals. Allan<sup>13</sup> showed that they appeared once a month or oftener in 82 per cent of 566 cases. They are variously attributed to disturbances in lipid metabolism, hepatic dysfunction, diets too rich in sugar or protein, anaphylactic reactions, plugging of a foramen of Monro, etc. Needless to say, these explanations hardly seem to explain menstrual headaches. Their definite relation to menstruation, pregnancy, and the menopause, indicates some connection with the endocrine system. Abbott<sup>1</sup> claims that they have an ovarian origin and states that his cases improved after the administration of corpus luteum. Abel<sup>2</sup> recommends a migraine serum made by Bohnstedt from the placenta. In the light of our present knowledge, it seems probable that this substance contains a large amount of ovarian hormone, which explains the good results produced. More recently Fishbaugh has published the histories of 13 patients afflicted with menstrual headaches, all of whom obtained relief from ovarian therapy. He admits, however, that some cases do not respond to this type of treatment and cites two examples. Sufficient evidence is at hand, therefore, to indicate that ovarian function plays a rôle in the causation of the headaches under consideration.

It is well known that the endocrine glands are dependent one upon another, but the exact nature of the interrelationship is poorly understood. A close connection between the sexual apparatus and the pituitary gland undoubtedly exists. Blumgarten<sup>5</sup> describes a syndrome quite similar to the one outlined above. It is his opinion that the demand on the pituitary is excessive during menstruation and the attempt of the gland to enlarge sufficiently to meet the overload produces the headaches. He claims real success from the administration of pituitary extract. Par-

dee<sup>28</sup> has encountered a clinical picture characterized by frontal headaches often at the time of the menses, somnolence, mental dullness, polyuria, increased sugar tolerance or glycosuria, oculomotor palsies, hemianopsia, abnormal bony growth and hair distribution, adiposity, and sexual regression, which he attributes entirely to pituitary dysfunction and cures through administration of the whole gland. Timme,<sup>37</sup> who has made an intensive study of headaches of hypophyseal origin, divides those due to an enlarged gland not of a neoplastic nature into three classes: (1) those having had previous operative or other critical disturbances of the gonads; (2) those in whom a status thymicolymphaticus preceded the pituitary symptoms, and (3) those having a long-standing thyroid insufficiency. The cases under consideration do not fall exactly into any of these classifications, but the pituitary cannot be ruled out as an active agent in the mechanism that produces menstrual headaches.

Ehrenfest<sup>11</sup> states that Aschheim and Zondek have shown that the urine of pregnant women contains very large amounts of both ovarian and pituitary hormones and smaller quantities are found in the other body fluids. It may be, therefore, that the active functioning of these glands is responsible for the absence of headaches during pregnancy and the success obtained by the administration of gland extracts in certain cases may depend upon the proper re-balancing of the hormones within the body. Assuming that both the ovary and the hypophysis are at fault, Tierney<sup>36</sup> has succeeded in relieving a patient with menstrual headaches by the administration of corpus luteum and extract of the anterior lobe of the pituitary simultaneously, although he chooses to call the condition migraine.

Several explanations of the mechanism of menstrual headaches have been offered but none of them are entirely satisfactory. Hartung,<sup>16</sup> in discussing a similar condition

which he calls migraine, claims that the pain is caused by an enlargement of the pituitary within its rigid container, the sella turcica. Tierney states that J. Herbert Fisher of the Royal London Ophthalmic Hospital, who suffers from migraine himself, accepts this theory. Sargent<sup>33</sup> goes a step farther and claims that an enlargement of the pituitary produces an elevation of blood pressure which in turn produces the pain. It must be remembered, however, that the hypophysis enlarges during pregnancy and also at times during the menopause, and yet menstrual headaches are usually absent during these periods. The frequent association of nausea and vomiting suggests the possibility of an increased intracranial pressure at the time of the attack, but the writer has been unable to find accurate reports of the appearance of the eye grounds or of changes in blood pressure at the time of onset of the headache.

Be the mechanism of the pain production what it may, the causation of the syndrome seems to be definitely tied up with the activity of the pituitary and the ovaries. Intelligent therapy should hinge upon the regulation of their function. The output of their products can be augmented by the administration of gland extracts and this method of treatment has already been referred to. However, we have available a powerful force in the form of radiation which, in view of its peculiar action on gland structures, should be a most valuable aid in attacking this problem. As regards the sexual apparatus, it is only necessary to mention the well-known paralyzing effects of large doses of radiation on the gonads, and the fact that many workers have been able to re-establish a normal flow in cases of functional amenorrhea, by subjecting the ovaries to small doses of roentgen rays. Drips and Ford<sup>10</sup> produced decided improvements in a group of cases of primary oligomenorrhea, amenorrhea, menorrhagia, and metrorrhagia, by administering small doses of roent-

gen rays to the ovaries and hypophysis on the supposition that the underlying cause in each instance was an ovarian hypoactivity. Del Buono<sup>8</sup> produced similar results by applying small doses to the pituitary region alone. Werner<sup>10</sup> used a similar technique, except that he also applied small doses to the thyroid in refractory cases. It is his contention that this method has a beneficial effect on dysmenorrhea, amenorrhea, menopause symptoms, and pregnancy toxicoses, especially hyperemesis and hypersalivation. Mild irradiation of the pituitary and thyroid as an efficient method of treating menopause symptoms such as hot flashes, sweating, coldness and tingling of the extremities, etc., has been advocated by Borak,<sup>6</sup> Heimann,<sup>17</sup> Porchovnik,<sup>29</sup> Kaplan,<sup>19</sup> and others. Szenes and Palugyay<sup>34</sup> have analyzed the symptoms in a series of cases treated in this way and it is interesting to note that 14 out of 28 patients complaining of headache obtained more or less relief, while 2 women developed headaches that they had not previously complained of. The proper use of radiation in endocrinology is perhaps not well understood, but its potency in influencing the glands of internal secretion can no longer be doubted.

Since many patients obtain relief from their menstrual headaches after the menopause, the artificial production of the change demands consideration. Fishbaugh<sup>14</sup> describes 2 cases that obtained relief in this way. One had a menopause produced by irradiation, and a complete hysterectomy was done for the other. Caesar,<sup>7</sup> who believes that migraine in women has an ovarian origin, recommends roentgen castration as the logical method of treatment. It may be of interest to report of few of our cases that have responded to this form of therapy:

CASE I. A married woman, aged forty-two, came to the hospital in August, 1923, complaining of a "pinching sensation" in the lower abdomen for about ten days following each

period, extreme nervousness, and recurrent headaches.

Her menses began at the age of eleven and she developed a severe dysmenorrhea. At

ache, she felt very dull and her memory began to fail, so that she often stopped speaking in the middle of a sentence because of an inability to remember what she had started to say. She

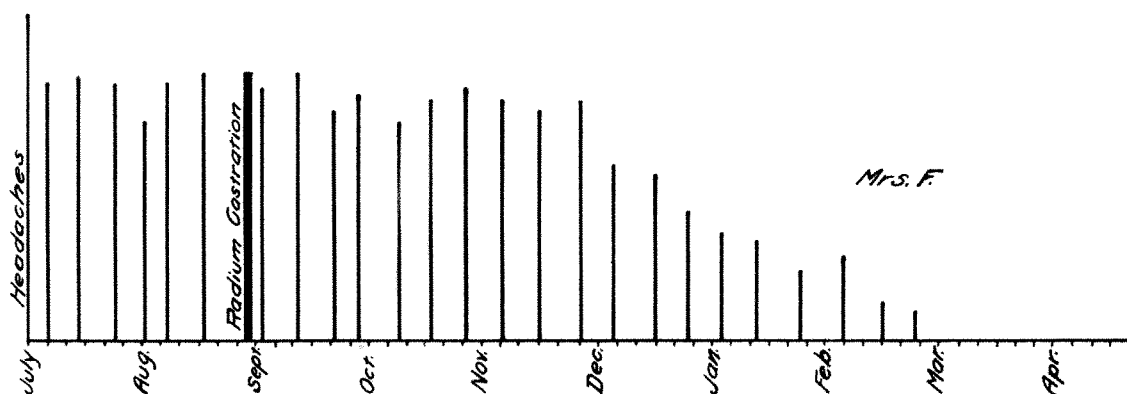


FIG. 1. Chart illustrating the gradual cessation of menstrual headaches after radium castration in Case 1. The severity of each attack is represented by the height of each vertical line. These lines are spaced in accordance with the time of appearance of the headaches. This patient has remained well for four and a half years.

eighteen she was thrown from a wagon and was badly jolted up, although no organic injury was discovered. From that time on an occipital headache preceded each menstrual period and lasted two to four days. She had no nausea or vomiting with the attacks. The pain extended from the back of the neck to the top of the head and was of a throbbing character. She had no visual disturbances.

At sixteen she weighed 135 lbs. and thought she was in good health. At twenty when she married, her health was not good and she weighed 110 lbs. She steadily became weaker, developed a leucorrhea and complained of pain low in the back and in the lower left abdomen. At that time her hands and feet were often numb and she had frequent fainting spells. At twenty-four, when she became pregnant, her weight was 97 lbs. During pregnancy she gained considerable weight and thinks her headaches cleared up, although she is not sure. Delivery was uneventful and she retained the weight she had gained.

For some two or three years before admission, the headaches had appeared three or four times a month, but a severe attack always accompanied menstruation. During this same period, a severe pinching sensation appeared in the lower portion of the abdomen after each period. This condition was temporarily relieved on two occasions by a curettage. Following each head-

became very nervous and was much depressed mentally most of the time.

Examination revealed a well-developed woman weighing 160 lbs. The uterus was normal in size, shape, and position. There was some tenderness in the vaults, particularly on the left side, but no definite masses could be made out. The sella turcica measured 12 × 10 cm.

One 50 mg. radium capsule having a filtration of 1 mm. of brass and 1 mm. of rubber was placed in the fundus of the uterus for nineteen hours, and the pelvis was cross-fired with roentgen rays through five portals of entry, each area receiving 30 ma-min., with a target skin distance of 10 in., a filter of 3 mm. of aluminum and a kilovoltage of 120.

For a month thereafter, she had a slight bloody discharge and felt nervous and let down. The discharge then ceased permanently, but her headaches continued as severe as ever for about two months. They then began to decrease in severity, and during the next three months she steadily improved in every way. At the end of the six-month period the nervousness, depression, and spells of forgetfulness had practically disappeared, and she had only an occasional headache of slight severity. Hot flashes appeared two months after the administration of radiation and continued for about one and one-half years, but they were never



troublesome. For the past four and one-half years she has enjoyed excellent health and states that she feels as well mentally and physically as she did at the age of sixteen.

the return of the periods. For several years, the pain in her head had appeared once or twice between periods. She was very nervous and had occasional hot flashes.

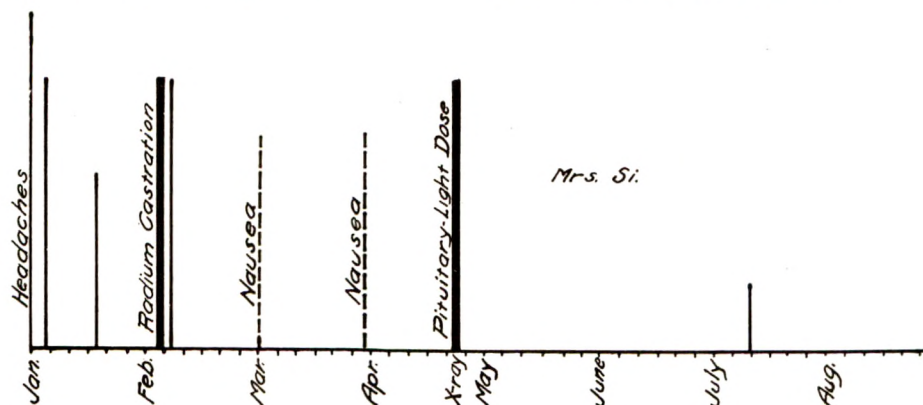


FIG. 2. Almost immediate cessation of menstrual headaches after radium castration in Case II. Menopause symptoms were relieved by light doses of roentgen rays administered to the pituitary.

Although this patient obtained an excellent end-result, her headaches continued for six months after she was treated and she was very uncomfortable during the first half of this period. The results in the next case offer a marked contrast in that only one headache appeared after the castration dose was given.

**CASE II.** A married woman, aged fifty-two, came to the hospital because of menstrual irregularity and menorrhagia of two years' duration. The periods were quite profuse, sometimes lasting for weeks at a time. For a year she had had hot flashes and had complained of increasing nervousness.

At puberty she began to have severe headaches with each menstrual period, beginning in the back of the neck and extending to the top of the head. These attacks lasted from one to three days and were accompanied by nausea and vomiting of such severity that she was usually confined to bed. During the height of the attack, there were spots and flashes of light before her eyes. She thinks the ingestion of sugar, worry and excitement, made the attacks much worse. Nothing that she could do produced relief, but she was most comfortable when receiving large doses of aspirin while she remained absolutely at rest in a dark room.

During pregnancy the headaches entirely disappeared only to return as bad as ever with

The patient was a very large pale woman. The uterus was slightly enlarged and normal in shape and position. The vaults were negative. A curettage obtained a considerable amount of endometrium which showed a simple hyperplasia on histological examination.

Fifty mg. of radium in one capsule, filtered with 1 mm. of brass and 1 mm. of aluminum, was placed in the fundus of the uterus for twenty-four hours and 270 ma-min. was applied to the lower abdomen anteriorly using 200 kv. and a filter of 0.75 mm. of copper and 1 mm. of aluminum at a target skin distance of 50 cm.

The menses ceased immediately after the treatment was given, but the hot flashes and nervousness became much worse. At the time of each period she had rather severe nausea and vomiting, but the headaches did not reappear.

About three months after the pelvic irradiation was given, 60 ma-min. was directed at the pituitary through each temple, using portals 4 in. square with a kilovoltage of 200, a filter of 0.75 mm. of copper and 1 mm. of aluminum, and a target skin distance of 50 cm. The attacks of nausea and vomiting ceased at once and the hot flashes became so infrequent as to be almost negligible. There has been only an occasional headache of slight severity since the castration dose was given. She has shown no change in weight for several years.



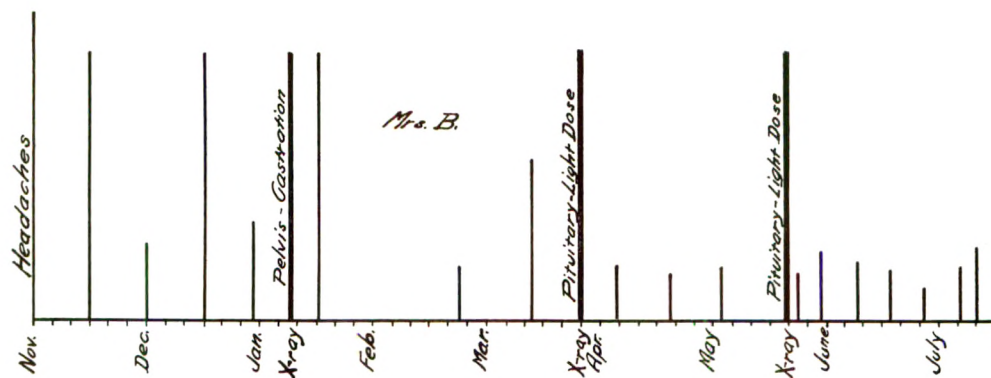


FIG. 3. Menstrual headaches partially relieved by roentgen castration in Case III. The patient still has frequent light attacks, not relieved by roentgen rays administered to the pituitary.

She feels that her general condition is now better than it has been for years.

Unfortunately, it is not always possible to obtain such clean-cut results. The following case is one in which only partial success was obtained, although the patient insists that she is much better.

CASE III. A married woman, aged forty-two, consulted us because of menstrual headaches and menorrhagia.

Her menses began at the age of twelve. Each period was ushered in by a severe headache, accompanied by nausea and vomiting. The pain usually began in the "cheek bones" and extended to the vertex and sometimes all over the head. It lasted twenty-four to forty-eight hours. Her mother and sister were afflicted in a similar manner. At thirty-four

she became pregnant and the headaches disappeared entirely, only to reappear as bad as ever when the periods were re-established.

At forty the regular attacks gradually became more severe and headaches of lesser severity began to appear between the periods. Her tonsils were removed, also the teeth, and the sinuses gone over without relief. She was given purgatives, although her bowels always moved regularly. For a time she obtained some relief from injections of pituitary extract and ovarian extract, but these remedies soon lost their effect. Coal tar products lost their potency, and for about six months prior to the radiation therapy she received three or four hypodermic injections of morphine during each attack before she was relieved of the excruciating pain in her head and the uncontrollable vomiting. She lost about 18 lbs. during this period, but although she was steadily losing ground, she maintained an unusually optimistic attitude towards her trouble. Her last period before coming to the hospital was profuse and lasted eleven days, but she had never suffered from any menstrual irregularity before.

The patient was a slender woman who showed evidence of recent weight loss. The uterus was normal in size and shape and in third degree retroversion. Films of the sinuses were negative. A lateral view of the skull showed a normally shaped sella turcica which had an unusually small size. It measured  $6 \times 10$  cm. Two hundred and seventy ma-min. was administered to the pelvis through each of two 20 cm. ports, one in front and one behind, using 200 kv., a filter of 0.75 mm. copper and 1 mm. aluminum and a target skin dis-

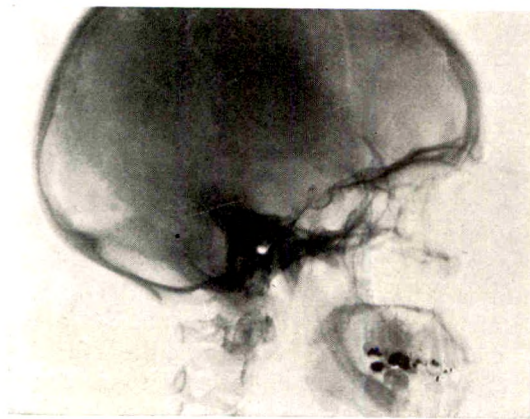


FIG. 4. A lateral view of the skull of Case III. The sella turcica is unusually small, but not otherwise abnormal.



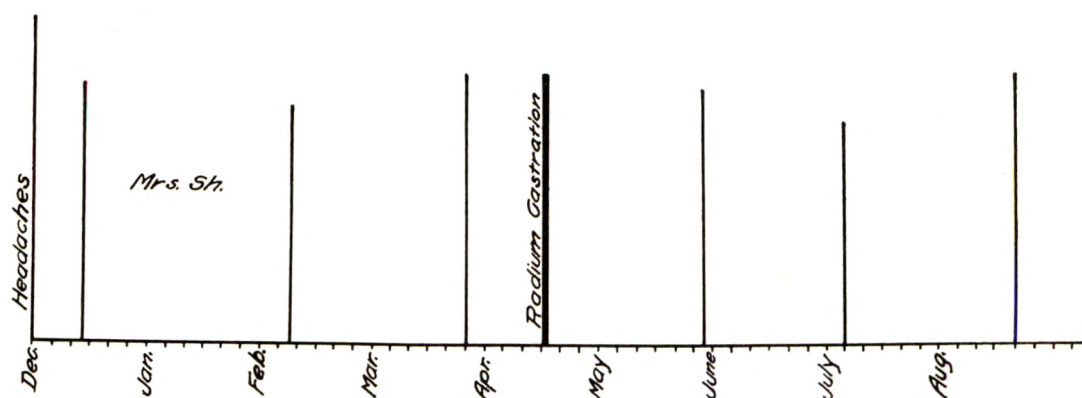


FIG. 5. Menstrual headaches not influenced by radium castration in Case IV. It seems likely that this patient has the so-called "pituitary headaches" which might be relieved by pituitary extract.

tance of 50 cm. A day elapsed between the two treatments.

Six days later, a period began with an unusually severe headache lasting four days and she menstruated seventeen days. There have been no more periods. About six weeks after she was treated, she had a mild headache and a more severe one appeared about sixteen days later. Soon after this attack, and again about six weeks later, she received 60 ma-min. directed to the pituitary through a small portal in each temple, using 200 kv., a filter of 0.75 mm. copper and 1 mm. aluminum, and a target skin distance of 50 cm. After the first dose was given to the pituitary region, the headaches appeared every eight to ten days, but were rather mild and usually lasted only a few hours. During six months of observation she has received no more hypodermics, but her physician gives her papine for some of the attacks. Although her general condition seems much improved, she has lost 10 lbs. since the castration dose was given, and is still having relatively mild headaches at frequent intervals.

The continued loss of weight and recurrent mild headaches that this patient has are puzzling. The pleasant effects produced by small doses of roentgen rays directed to the pituitary in Case II led us to try the same method on Case III. Light headaches began to appear at frequent intervals as soon as this therapy was started, and the rôle played by the roentgen rays in their production is an open question. It seems possible that they may eventually disappear when the endocrine balance is finally

re-established. Unfortunately, castration does not always bring relief. The following case has shown no improvement of any sort during four months of observation:

CASE IV. A married woman, aged fifty-two, consulted us because her physician had removed a specimen of tissue from the cervix, which was diagnosed histologically as carcinoma. Although she had no signs or symptoms of malignancy, radiation therapy was advised as a safety measure.

At puberty she began to have severe frontal headaches, first on one side and then on the other, beginning before each menstrual period and lasting one to three days. The pain was sometimes referred to the eyes and temples, but was never accompanied by nausea or vomiting. She had no visual disturbances.

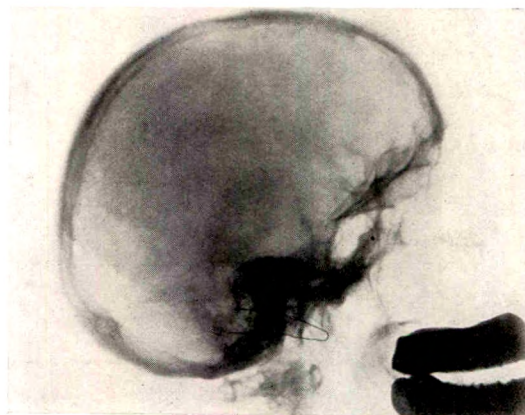


FIG. 6. A lateral view of the skull of Case IV. The sella turcica shows no abnormality except that the posterior clinoids are inclined backwards.



Excitement and worry made the attacks much worse and she obtained her greatest relief by lying quietly in a dark room.

At the age of eighteen she put on glasses, but the headaches continued to appear as before. During pregnancy the attacks occurred with their usual frequency. She has always been too fleshy. At forty-three she lost 83 lbs. on a diet of raw vegetables and buttermilk, and thinks her headaches were less severe at that time. However, the weight was soon regained after the diet was discontinued.

At forty-four her tonsils and turbinates were removed and her glasses were changed, but no improvement followed these procedures, and she thinks she has been worse ever since.

About two years before admission, her periods became irregular, often being spaced six weeks to three months apart. During this period she had two or three headaches between her periods, but a severe attack always accompanied menstruation.

The patient was a very large pale woman who weighed 253 lbs. No abnormalities could be made out in the pelvis except that the cervix showed evidence of a recent cauterization. Three 25 mg. radium capsules filtered with 1 mm. of brass and 1 mm. of aluminum were placed in tandem, so as to extend from the external os to the fundus, and were left in place for twenty-four hours; 240 ma-min. was then administered to the pelvis anteriorly through a port 20 cm. square, with 200 kv., a filter of 0.75 mm. copper, and 1 mm. aluminum and a target skin distance of 50 cm. During four months of observation, she has had no more periods, but her headaches have continued

about as they did before she was treated. She is again on a strict diet and has managed to lose 32 lbs. since leaving the hospital, but she is still much too fat. A lateral view of the skull made recently shows no definite abnormality in the size or shape of the sella turcica, which measures 14×13 cm. Her general condition does not show any definite improvement.

This patient's tendency to gain weight and the continuation of her headaches during pregnancy suggest that her condition may be somewhat different from that of the preceding cases. Her attacks are more like the so-called "pituitary headaches" and she has been advised to try a course of pituitary extract, if improvement does not appear within two months.

Having established the value of radiation castration as a treatment for menstrual headaches, the question immediately arises as to what is to be done with the young woman who suffers from this malady. Most radiologists agree that it is very undesirable to produce a menopause in a woman less than forty years of age. Timme<sup>37</sup> even states that "pituitary headaches" may be brought on by critical disturbance of the gonads. The following case illustrates one of the possible outcomes of such treatment.

CASE V. An unmarried woman, aged forty-three, consulted us because of severe headaches. During her menstrual life, she had headaches accompanied by nausea and vomiting with

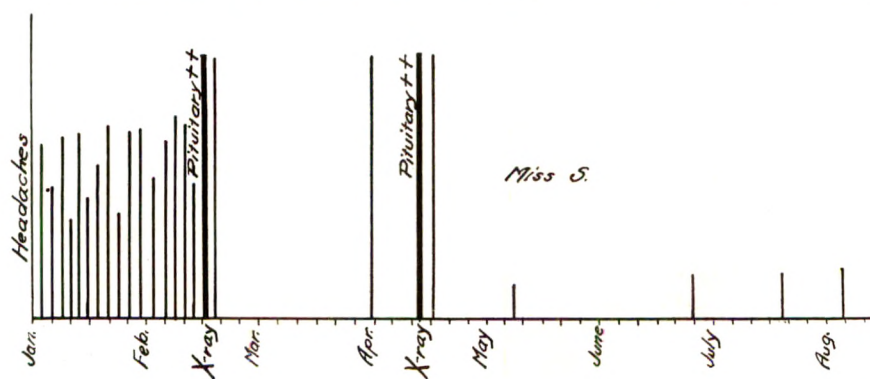


FIG. 7. Chart for Case v, who was relieved of menstrual headaches by a subtotal hysterectomy, but a few years later developed attacks in such a severe form that she was rarely free of headache. Two series of deep roentgen treatments applied to a much enlarged pituitary relieved her of most of her symptoms.



each period. These attacks usually lasted twelve to twenty-four hours. When she was thirty-two years old a hysterectomy was done for a uterine fibroid. She thinks the ovaries were not removed. The headaches ceased and she began to gain weight. When she was thirty-seven, she weighed 148 lbs., having gained a total of 27 lbs.

At the age of forty she again developed severe headaches accompanied by nausea and vomiting. The pain always appeared in the left frontal region, starting behind the left eye and continued for about twenty-four hours. At first the attacks were about a week apart, but they gradually became more frequent until they were almost continuous. The pain was throbbing in character, much like that experienced with a "cavity in a tooth" and was usually accompanied by some dimming of vision. She could obtain no relief except from narcotics and at admission was sick almost all of the time.

The patient was a well-developed woman, weighing about 140 lbs. A gastrointestinal examination revealed no abnormality except some unexplained tenderness in the lower abdomen. A lateral view of the skull showed a definite enlargement of the sella turcica, which measured  $17 \times 18$  cm. The posterior horns appeared to be somewhat eroded. An ophthalmologist reported that the visual fields were not abnormal.

Deep roentgen rays were directed to the pituitary through the temples, 270 ma-min. being given through a 4 inch port to each temple on two successive days, using 200 kv.,

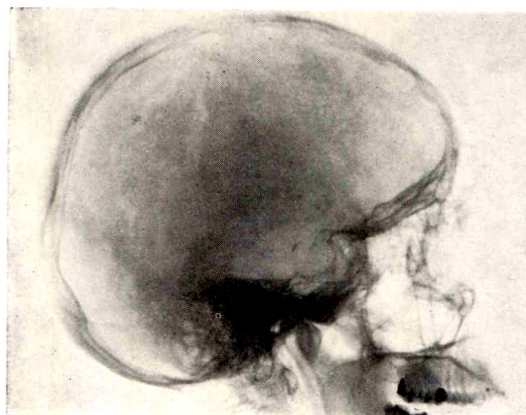


FIG. 8. Lateral view of the skull of Case v. Note the marked enlargement of the sella turcica.

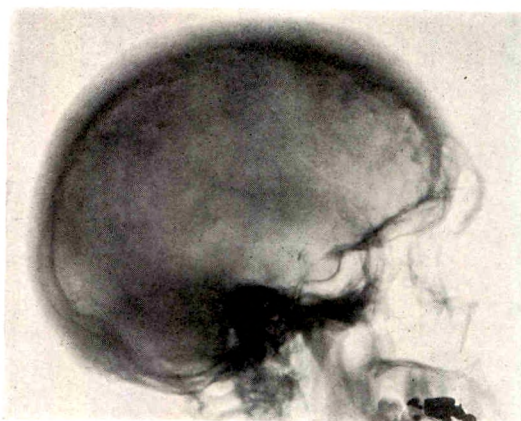


FIG. 9. Skull of a patient with acromegaly. The sella turcica is not quite so large as the one shown for Case v.

a filter of 0.75 mm. copper and 1 mm. aluminum and a target skin distance of 50 cm.

She had a very severe headache with nausea and vomiting immediately after she was treated, but was then entirely free of symptoms for six weeks, at the end of which time she had another severe attack.

When she recovered from this headache, the roentgen treatment was repeated, and it again brought on an intense headache with nausea and vomiting, which soon cleared up. During four months of observation, she has had four very mild headaches which were relieved by aspirin and which she attributes to a pyelitis that recurs at intervals. Her general condition is much improved.

Although a hysterectomy produced relief of symptoms for a time, it seems possible that the ensuing decrease in ovarian function may have been a factor in producing hypertrophy of the hypophysis. The appearance of the sella turcica was consistent with the formation of an adenoma of the pituitary and treatment was administered on the assumption that such a tumor existed. Radiation has been recommended for this condition by Fejér,<sup>13</sup> Ranschburg,<sup>31</sup> Terrien,<sup>35</sup> Blumberg,<sup>4</sup> Enfield,<sup>12</sup> Roussy, et al.,<sup>32</sup> Wehefritz,<sup>39</sup> Grant,<sup>15</sup> Dott, Bailey and Cushing,<sup>9</sup> Nemenow and Jugenburg,<sup>25</sup> Towne,<sup>38</sup> Heinismann and Czerny,<sup>18</sup> Nordentoft,<sup>26</sup> Kaplan,<sup>20</sup> and many others. These authors report im-





FIG. 10. Skull of Case VI. The sella turcica is large and the posterior clinoids appear to be thinned out in their lower portions. No benefit was obtained from irradiation in this case.

provement in partial blindness, diabetes insipidus, dystrophia adiposogenitalis, and acromegaly secondary to intensive irradiation of enlarged pituitary glands, and it seemed logical to apply similar treatment in the case just cited. The results justified the procedure, but it would hardly be fair to assume that a similar pelvic operation would be successful in all young women, or that a similar enlargement of the pituitary might occur which could be efficiently handled by roentgen therapy. The following case illustrates an entirely different result which followed castration:

**CASE VI.** An unmarried woman, aged forty, consulted us because of severe headaches. Her periods began at the age of thirteen, at which time they were normal and were not accompanied by headaches. However, at twenty-five the menses became profuse and irregular and she developed right-sided frontal headaches, which preceded each period and usually lasted one day. She had no nausea or vomiting. As time went on it was necessary to use codeine to relieve the pain. At thirty-four her physician advised her to have an artificial menopause produced because of a troublesome menorrhagia. She received in another city a number of roentgen treatments over the pelvis, and after two years her periods ceased entirely. However, after they stopped, the headaches continued in a more troublesome form, ap-

pearing every three weeks at first and gradually becoming more frequent, so that at admission they were spaced about a week apart. They had been increasing steadily in severity, so that even a quarter grain of morphine did not give complete relief, and nausea and vomiting appeared with them. She thinks the ingestion of sugar, overwork, worry and excitement, made the attacks much worse. She did not have a polyuria, but often complained of black spots before her eyes, flashes of light, and dimness of vision while the pain was at its worst.

During the six months prior to admission, she received ovarian extract, pituitary extract, mineral baths, massage, cathartics, Morse wave treatments, and gall-bladder drainages, without improvement. She then had her appendix and tonsils out, and the teeth and sinuses received attention, but the headaches continued as bad as ever.

The patient was a slender, bright, alert, nervous woman. She wore glasses and her hair was prematurely gray. A lateral view of the skull showed the sella turcica slightly enlarged and the posterior horns appeared to be thinned out in their lower portions. The sella measured  $12 \times 15$  mm.

Sixty ma-min. was directed to the pituitary through each temple, using 200 kv., a filter of 0.75 mm. copper, and 1 mm. aluminum and a target skin distance of 50 cm. After two weeks of observation, during which no improvement was noted, 180 ma-min. was directed at the pituitary through each temple, using the same factors. This treatment precipitated a very severe headache, requiring several hypodermic injections of morphine. During two months of observation, she has continued to have headaches just as she did before the treatment was given. Her weight has decreased slightly during the past year.

In this case, it seems quite apparent that the headaches became much worse after the artificial menopause was produced. Although the roentgen appearance of the sella suggested an increase in the size of the hypophysis, intensive roentgen therapy did not produce relief as it did in Case V. Although too many conclusions cannot be drawn from only one case, it would seem that one is treading on thin ice in advising

castration as a therapeutic measure for young women suffering with menstrual headaches.

Considerable evidence has been collected to show that castration produces definite changes in the hypophysis. Livingston<sup>22</sup> described his findings in rabbits a number of years ago and observed that in some spayed animals the pituitary increased as much as 23 per cent in weight, whereas in others no change was observed. He also noted that animals showing an increase in the size of the pituitary showed no increase in body weight, and vice versa. Many explanations of the changes in the hypophysis have been advanced. Nukariya<sup>27</sup> finds many signet ring shaped cells filled with colloid in the pituitary glands of castrated rats and calls them castration cells. He thinks they are formed from the normal basophiles. Maffeo<sup>23</sup> worked with castrated dogs and found a marked increase of connective tissue of the hypophysis. Lehmann<sup>21</sup> finds a different histological picture in the pituitary during pregnancy and after castration. The pregnant animals show a marked hyperemia and an increase in chief cells in the gland, whereas after castration there is an increase in the basophile cells. Mariani<sup>24</sup> found multiple round hyaline masses in the hypophyses of capons after castration.

Although experimental workers are not in strict agreement relative to the exact changes produced, all seem to believe that inactivation of the ovaries has a definite effect on the hypophysis. The possible relation of this effect to the relief of men-

strual headaches in women nearing the menopause demands consideration. There may be a difference in the reaction of the pituitary following the cessation of gonad function in young women and women of menopause age. This difference probably accounts for the very severe menopause symptoms appearing in young women after castration, some of which can be relieved by irradiation of the hypophysis. Although the problem is a most complex one, repeated trials may finally evolve a technique whereby the various endocrine glands may be irradiated in just the proper manner to prevent recurrent menstrual headaches, without producing the menopause. Such treatment could be given patients of any age, and would be such a boon to woman-kind that a considerable amount of experimentation on human subjects seems entirely justifiable, even though the methods used be entirely empirical.

#### CONCLUSIONS

1. One type of menstrual headache, characterized by pain in the occipital or frontal regions, and nausea and vomiting, and relieved during pregnancy, probably has an endocrine origin.
2. This type of headache may be partially or completely relieved in a certain number of women past the age of forty by the production of an artificial menopause with irradiation.
3. The use of castration in younger women seems of doubtful value and may even accentuate the symptoms.

#### REFERENCES

1. ABBOTT, S. K. Periodic headaches of ovarian origin. *N. York M. J.*, 1920, 112, 724.
2. ABEL, S. The use of migraine serum "Bohnstedt" in gynecology. *Deutsche med. Wchnschr.*, 1921, 47, 1229-1230.
3. ALLAN, W. Status hemicranicus and frequency of migraine attacks. *J. Nerv. & Ment. Dis.*, 1928, 68, 591-593.
4. BLUMBERG. Roentgenotherapy of pituitary tumors and of gynecologic diseases of pituitary origin. *München. med. Wchnschr.*, 1922, 69, 739-741.
5. BLUMGARTEN, A. S. The endocrine factors in some common functional diseases. *M. Clin. N. Am.*, 1921-1922, 5, 1022-1066. (Pituitary headaches, p. 1029.)
6. BORAK, J. The treatment of climacteric symptoms by irradiation of the pituitary and thyroid glands. *Brit. J. Radiol.*, 1924, 29, 293-296.

7. CAESAR, G. Migraine attacks, their signs, causes and nature with special consideration of the reciprocal action between migraine and sexual life. *Med. Klin.*, 1913, 9, 49-53.
8. DEL BUONO, PIETRO. Roentgen irradiation of the hypophysis in dysfunction of the uterus and ovaries. *Radiol. med.*, 1927, 14, 292-300.
9. DOTT, N. M., BAILEY, P., and CUSHING, H. Consideration of hypophysial adenomata. *Brit. J. Surg.*, 1925, 13, 314-366.
10. DRIPS, DELLA G., and FORD, FRANCES A. Irradiation of the ovaries and hypophysis in disturbances of menstruation. *J. Am. M. Ass.*, 1928, 91, 1358-1364.
11. EHRENFEST, HUGO. Ovarian and hypophyseal hormones in the urine during pregnancy. *J. Missouri M. Ass.*, 1929, 26, 113-115.
12. ENFIELD, CHAS. D. Acromegaly following gigantism; report of case treated by roentgen rays. *Radiology*, 1924, 3, 492-496.
13. FEJÉR, J. Treatment of tumors of the hypophysis. *Berl. klin. Wchnschr.*, 1921, 58, 1221.
14. FISHBAUGH, ERNEST C. Headache in relationship to ovarian dysfunction. *Endocrinology*, 1927, 11, 445-456.
15. GRANT, F. C. The results in x-ray treatment of early pituitary lesions. *Atlantic M. J.*, 1926, 29, 430-435.
16. HARTUNG, E. F. Present day aspects of migraine. *N. York State J. M.*, 1927, 27, 240-243.
17. HEIMANN, FRITZ. Mild irradiation. *Klin. Wchnschr.*, 1925, 4, 1815-1818.
18. HEINSMANN, J. I., and CZERNY, L. I. Roentgen therapy of tumors of the hypophysis. *Strahlentherapie*, 1926, 24, 331-335.
19. KAPLAN, A. L. Roentgen therapy of climacteric changes. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, 38, 565-568.
20. KAPLAN, I. I. Roentgen ray therapy in pituitary tumors. *J. Am. M. Ass.*, 1925, 85, 268-269.
21. LEHMANN, J. The structure of the hypophysis of castrated and non-castrated rats under the influence of placental substances given internally and parentally. *Virchow's Arch. f. path. Anat. (etc.)*, 1928, 268, 346-373.
22. LIVINGSTON, A. E. The effect of castration on the weight of the pituitary body and other glands of internal secretion in the rabbit. *Am. J. Physiol.*, 1916, 40, 153-185.
23. MAFFEO, L. Changes in laryngeal and pituitary mucous membrane in castrated dogs. *Folia med.*, 1927, 13, 1164-1170.
24. MARIANI, G. Changes in the hypophysis in castrated capons. *Atti d. r. Accad. d. fisiocrit. in Siena*, 1928, 3, 5.
25. NEMENOW, M., and JUGENBURG, ANNA. Radiation therapy of tumors of the hypophysis. *Strahlentherapie*, 1928, 30, 239-276.
26. NORDENTOFT, J. Good effects of roentgen treatment in a case of tumor of the hypophysis. *J. de radiol. et d'électrol.*, 1928, 12, 280-283.
27. NUKARIYA, S. Relations between the generative gland and the pituitary body. *Klin. Wchnschr.*, 1925, 4, 1307-1308.
28. PARDEE, I. H. Pituitary headaches and their cure. *Arch. Int. Med.*, 1919, 23, 174.
29. PORCHOWNIK, J. B. The treatment of climacteric symptoms by means of irradiation of the thyroid and hypophysis according to Borak. *Strahlentherapie*, 1927, 24, 701-709.
30. Queries and Minor Notes. *J. Am. M. Ass.*, 1929, 92, 1375.
31. RANSCHBURG, P. Two cases of hypophyseal dystrophia adiposogenitalis treated by roentgen rays. *Deutsche med. Wchnschr.*, 1921, 47, 1291.
32. ROUSSY, G., ET AL. Roentgenotherapy in the treatment of tumors of infundibulo-hypophyseal region. *Rev. neurol.*, 1924, 31, 297-315.
33. SARGENT, L. D. Pituitary headaches. *Pennsylvania M. J.*, 1929, 32, 333-335.
34. SZENES, A., and PALUGYAY, J. The results of roentgen irradiation of the hypophyseal region in cases with symptoms of menopause. *Wien. klin. Wchnschr.*, 1925, 38, 503-507.
35. TERRIEN, F. Radiotherapy of visual disorders due to tumors of the hypophysis. *Presse méd.*, 1922, 30, 429-431.
36. TIERNEY, JOHN L. Headache. *M. Clin. N. Am.*, 1923-1924, 7, 1515-1544.
37. TIMME, WALTER. The glandular treatment of pituitary tumors and hyperplasias. *Atlantic M. J.*, 1926, 29, 427-430.
38. TOWNE, E. B. Cessation of diabetes insipidus on roentgen ray treatment of pituitary gland. *J. Am. M. Ass.*, 1924, 83, 2085-2087.
39. WEHEFRITZ, E. Roentgen irradiation of tumors of hypophysis. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1923-1924, 31, 680-691.
40. WERNER, PAUL. Roentgen ray treatment of benign gynecological diseases. *Am. J. Obst. & Gynec.*, 1927, 13, 54-60.

## DISCUSSION

DR. H. J. ULLMANN, Santa Barbara, Calif. There is one thing in Dr. Martin's paper that interested me very much, the question of dosage. Dr. Martin spoke of aggravation fol-

lowing a large dose and the possibility of getting results in one case where the doses were spaced at a considerable distance apart.

I have been treating a number of ovarian



dysfunctions, if I may use that term, and also am now treating a diabetes insipidus, to see what can be done. I have found that in treating the pituitary, whether for ovarian dysfunction or for the hot flashes of the menopause, the optimum dose was approximately between 70 and 80 r-units delivered to the skin through one side. This is approximately what is being used at the Mayo Clinic. In one case I raised the dose to 112 r, an increase of 40 per cent, and produced a marked aggravation of symptoms. On allowing the patient to rest for a week and then repeating the smaller dose, the patient again obtained relief. I suggest that small doses be tried at shorter intervals in some of these cases that received no benefit with the large doses at long intervals.

DR. HUNTER. What does Dr. Martin think about headaches during pregnancy?

Second, what about colonic stasis?

Third, has he had any experience in treating trifacial neuralgias that occur in pregnancy by irradiation?

DR. MARTIN (closing). I am afraid I cannot answer all the questions that Dr. Hunter asked. As regards the headaches of pregnancy, I will again state that the patients considered in this paper do not have headaches during pregnancy. This is the most characteristic finding in their histories.

Colonic stasis is usually mentioned as a cause of menstrual headaches. Some of the cases in my series have had all sorts of treatment for this condition including irrigations, drugs, diets, Morse wave therapy, etc., with no relief. I feel that the syndrome really has an endocrine basis rather than a gastrointestinal origin. Dr. Hunter's question about trifacial neuralgia falls entirely outside my knowledge.

I appreciate the encouraging remarks made by Dr. Ullmann and I hope that some of the others in the Society will become interested in this subject and help to work out a successful treatment for menstrual headaches.



## TEN YEARS' RESULTS WITH RADIUM IN THE TREATMENT OF TOXIC GOITER\*

By R. E. LOUCKS, M.D.

DETROIT, MICHIGAN

REVIEWING past experiences and analyzing results in any new field of research is interesting and occasionally discouraging; but in this case the results have been so gratifying as to be worthy of more general application in the treatment of toxic goiter.

When Abbe and Aikins reported through this and other societies their results of this new treatment, which was largely empirical at that time, it stimulated an interest in the therapy that has been found efficient and proved satisfactory by clinical and laboratory means. The surgical mortality years ago was much higher than it is today and again, many of the protracted cases when poor surgical risks did not receive any treatment.

The advancement in medical science in the treatment of disease has kept pace with that of surgical intervention. The fact that many cases of toxic goiter in surgical hands are surgical does not disprove the fact that all such cases treated with radium by competent clinicians with approved technique can get equally as good results.

This advancement was not meant to replace surgery but to be another weapon in the armament of the skillful therapist to combat a disease that has not a definite etiological entity.

Fear of surgery without any other apparent alternative in the control of disease has sounded the closing chapter with many, and has sent others to the different cults outside the pale of scientific medicine. Cases of resistant toxic goiter that require two or more operations are a type that will require more radiation, which should always be considered in stating the prognosis.

The physiological studies of the thyroid gland with the isolation of thyroxin as one of the hormones, the pathological histology,

the different clinical manifestations of the disease and the laboratory estimation of metabolism in health and disease of the gland have been the factors to stabilize the evaluation of the symptoms of a hyperactive thyroid gland.

Whether there is an inherited predisposition or that the dysfunction is due to some chemical deficiency or bacterial invasion cannot be discussed at this time. A physiological activation of the thyroid gland will give an increased metabolism, yet the clinical symptoms are not classical of pathological thyrotoxicosis. A positive differentiation between a physiological or functional activity and toxic hyperthyroidism should always be made before remedial measures are instigated.

For the relief of a clear-cut toxic adenoma or an exophthalmic goiter the indication is surgery or irradiation by radium. A conglomerate therapy of a few doses of roentgen rays for a few weeks, radium in small doses every month and probably some electric modality indicates an indefinite understanding of the procedure.

The results of radium treatment seem most gratifying since not one patient has died from the treatment in over 500 cases. Twelve were operated on because of enlarged adenomas; of the 12 cases, 5 died within three days from embolism, shock or cardiac failure. Six other cases died within a month of the treatment, too soon to have received any benefit from the radiation; 3 of them were insane from the toxic condition, one being wild and hilarious and having to be restrained. These 3 cases should probably not have been treated, but after completely controlling the toxic goiter condition and incidentally the mental condition in two other mania cases, I was persuaded to give them the benefit of the

\* Read at the Fourteenth Annual Meeting, American Radium Society, Portland, Oregon, July 8-9, 1929.

treatment. Six had been refused surgical intervention while one had had the thyroid arteries ligated.

As noted in former reports, no two cases react the same to the treatment; one may show an increase in weight within two months, another note lessened tremor as the first improvement. Within the past year a few cases of toxic adenoma giving a low sugar tolerance have responded very quickly after treatment. No doubt the severe gastric and intestinal cases are caused by hepatic and pancreatic dysfunction.

When the chronic toxic thyroid has had a long course and damaged the endocardium and myocardium and eventually the kidney, the outcome is precarious. The toxicity may be controlled but the damage remains. Palliation by medical treatment with digitalis will often tide over an apparent crisis. Lugol's solution, like digitalis and the bromides, has done much harm in the past by increasing the thyroid activity and causing an immediate necessity for relief which can only be obtained by surgery. Radium radiation is slow in effect and gives better results when the toxicity has reached the peak and is subsiding.

Many individuals after thyroid surgery or radiation have a functional activation following influenza or tonsillitis, months or years after all symptoms of thyrotoxicosis have been controlled. Small doses of Donovan's solution of arsenic for a few weeks will act as a specific to this form of activity, the same as it does in the physiological activity of young persons of the high school age or young prospective mothers.

The arguments in favor of radium therapy in toxic thyroid are so many and have been brought forward by me so often in the past eight years that no repetition is needed here.

Three brief case histories follow:

CASE 1304. Mrs. E. B., aged thirty-two. Treated Jan. 30, 1928. Shaky and dizzy four months. Lost 25 pounds. Pulse 144. Blood

pressure 160/50. Weight 111 lbs. Metabolic rate +48 per cent. Tremor ++++. Large adenoma. Diagnosis: Toxic adenoma.

Two months after radium: Weight unchanged. Pulse 146. B. P. 156/56. Less tremor. Adenoma softer.

Five months after radium: Weight 117 (gain of 6 lbs.) Rate 120. B. P. 142/70. Feels much better.

Seven months after radium: Weight 123 (gain of 12 lbs.) Pulse 96. B. P. 144/72. Tremor of right hand.

Eleven months after radium: Feels very well. Nothing to suggest former condition. Pulse 90. Weight 133 (gain of 22 lbs.) B. P. 120/70.

Thirteen months after radium: Feels fine. Pulse 84. Weight 140 lbs. (gain of 29 lbs.) Neck much smaller.

CASE 1328. Miss N. F., aged thirty-five. Treated April 19, 1928. Extreme nervousness, weakness and palpitation for five months; had to be carried in. Pulse 120. Weight 98 lbs. Metabolic rate +48 per cent. Had had iodine five months previously. Diagnosis: Adenoma with hyperthyroidism.

Two months after radium: Feels much better. Tremor much improved. Pulse 86. Weight 108 (gain of 10 lbs.)

Ten months after radium: Had influenza a month ago but feels very well now. Pulse 64. No tremor. Weight 113 (gain of 15 lbs.)

The relation existing between hyperthyroidism and glycosuria has long been an interesting aspect of the study of goiter. In 1912 Van Noorden described "thyroid diabetes" and showed that glycosuria could be induced in man and animals by feeding thyroid tissue and also that it was nearly impossible to produce glycosuria in thyroidectomized animals. Glycosuria occurs in about 6 per cent of all cases of hyperthyroidism; it is found more often in acute cases, especially of the exophthalmic type. However, true diabetes is rarely coexistent with hyperthyroidism.

Studies in carbohydrate metabolism by DuBois and others show that the hyperthyroid patient is able to utilize carbohydrate normally but cannot store it in the form of glycogen, hence the glycosuria. The true diabetic differs in not being able to burn sugar in the normal way.

Hyperthyroidism is obviously a serious complication in diabetes because of the increased energy requirements associated with the raised metabolism. It is important in all goiter cases showing glycosuria to differentiate between true diabetes and a functional glycosuria. The diabetic with hyperthyroidism must be given a diet with enough calories to offset the increased metabolism, with sufficient insulin to take care of the extra food. The patient with functional glycosuria must receive sufficient calories to gain weight, ignoring the glycosuria which will doubtless clear up when the activity of the thyroid is controlled. The true diabetic will have the sugar tolerance raised as the basal metabolism falls under appropriate treatment.

This phase of hyperthyroidism has been emphasized because a proper perspective is essential to an accurate prognosis and a rational schedule of therapy. In this connection, a case history has been briefed, illustrative of unusual and almost spectacular results following radium. The case had been ranked as a moderately severe diabetes with hyperthyroidism as a complication, by the diabetic service of a famous city hospital and as such had been placed on an adequate diet with an appropriate amount of insulin. The case follows:

CASE 1337. Mrs. J. H., aged sixty-one. Treated in May, 1928. Gave a history of marked glycosuria for the past year. Took 20-40 units of insulin from August to November, 1927. Swelling of ankles. Weight two years ago 135 lbs. Last of August, 1927, 105 lbs. Weight when treated 85 lbs. Had been taken to large city hospital and put on 10 units of insulin three times daily and a diet of: protein 55 gm.; fat 200 gm.; carbohydrate 90 gm. Value of this diet 2350 calories. Was advised to have thyroidectomy; refused operation. Diagnosis: diabetes with toxic adenoma as a complication. At time of treatment, the pulse rate was 96; B. P. 154/66. Metabolic rate +44 per cent.

Three months after radium: Pulse 76. B. P. 148/68. Weight 103 (gain of 18 lbs.) Urine remained sugar-free in spite of the fact

that the insulin dosage had been gradually reduced in amount and no insulin had been given in the last two weeks.

Five months after radium: Pulse 64. B. P. 152/70. Weight 99 lbs. Urine showed trace of sugar; had been guilty of such dietary indiscretions as jelly, bananas, etc.

Eleven months after radium: Pulse 72. B. P. 144/75. Weight 101 lbs. Sugar-free urine. Carries on with housework, feeling very well; slight swelling of ankles after being on feet all day. Tremor gone. The adenoma has decreased in size by half.

*Summary.* Weight increased from 85 to 101 lbs. Pulse reduced from 96 to 66. Tremor gone. From glycosuria to sugar-free. Insulin reduced from 30 units to 0. Hyperthyroidism controlled; adenoma decreased to at least half its size. Patient now enjoys comparatively good health instead of invalidism.

This striking change in the diabetic-hyperthyroid picture adds another link to the chain of evidence establishing the validity of radium in the treatment of thyroid disease.

#### CONCLUSIONS

(1) Radium is highly effective in controlling hyperthyroidism, including the diffuse exophthalmic type as well as that associated with adenoma.

(2) Results with radium parallel those with surgery; the type of case that responds poorly to radiation is identical with that which requires two or more thyroid operations.

(3) Radium therapy accomplishes a marked restoration of sugar tolerance in cases associated with glycosuria, indicating a complete control of the hyperactive thyroid.

(4) The primary mortality is nil; pre-operative and postoperative morbidity is eliminated; from the standpoint of the period of disability, hospital expenses and the concomitant loss of wage-earning power, radium holds a tremendous economic advantage over any other therapeutic procedure.\*

\* For discussion see page 297.



## THE VALUE AND PLACE OF RADIUM IN TREATMENT OF DISEASES OF THE THYROID GLAND\*

By SOLOMON GINSBURG, M.D.

NEW YORK CITY

**D**URING the years 1922 to 1928 I have had the opportunity to study intensively some 500 patients affected with various types of goiter. Clinically, these cases were classified into the following five groups:

1. Diffuse nontoxic, or simple goiter.
2. Nodular nontoxic, or simple adenomatous goiter.
3. Nodular toxic, or toxic adenomatous goiter.
4. Diffuse toxic, or exophthalmic goiter.
5. Malignant, or cancerous goiter.

*Diffuse Nontoxic, or Simple Goiter.* Patients affected with this type of goiter formed, next to malignant goiter, the smallest group in our series. In its uncomplicated form, unassociated with adenomas,

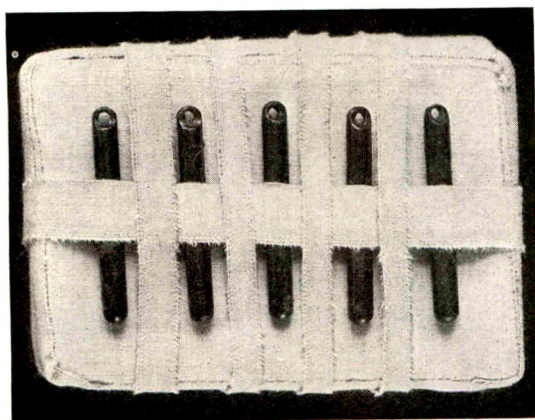


FIG. 1. Radium "block." The radium block is made of balsa wood. Its dimensions are 7 by 5 by 3 cm. It is covered by adhesive plaster. Several layers of gauze are interposed between it and the skin to serve as a cushion and to absorb perspiration. The distribution of the radium capsules is shown above. Each brass capsule, of 1 mm. wall thickness, contains 10 to 25 mg. of radium in standard steel needles, according to indications. The block is strapped in place by means of adhesive plaster and reinforced with a bandage.

simple goiter was almost invariably found in juvenile patients only. None of these uncomplicated cases were subjected to radium therapy. They were all treated by

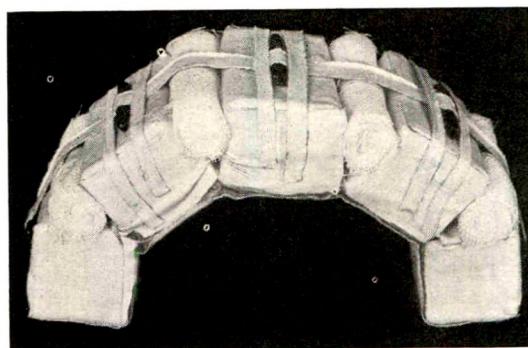


FIG. 2. Radium "collar." The radium collar is made of five blocks of balsa wood, each block measuring 5 by 3 by 3 cm. The blocks are held together by adhesive plaster. Their proper adjustment to the neck is obtained by pledgets of gauze. The distribution of the radium capsules is shown above. Each brass capsule, of 1 mm. wall thickness, contains 10 to 25 mg. of radium element in standard steel needles, according to indications. The collar is strapped in place by adhesive plaster and reinforced by a bandage.

general medical measures plus iodine medication extending over a period of several months to a year. The results were very gratifying. Invariably either the thyroid gland shrank in size or failed to show any further abnormal growth.

In the remaining four groups of cases radium therapy was carried out by means of the following two applicators: (1) the radium "block" (Fig. 1); (2) the radium "collar" (Fig. 2).

The radium "block" is made of balsa wood. Its dimensions are 7 by 5 by 3 cm. It is covered by adhesive plaster. Several layers of gauze are interposed between it

\* From the Radium Clinic of Beth Israel Hospital, New York City. Read at the Fourteenth Annual Meeting, American Radium Society, Portland, Oregon, July 8-9, 1929.

and the skin to serve as a cushion and to absorb perspiration. The distribution of the radium capsules is shown. Each brass capsule, of 1 mm. wall thickness, contains 10 to 25 mg. of radium in standard steel needles, according to indications. The "block" is strapped in place by means of adhesive plaster and reinforced with a bandage; 3000 mg-hr. constitutes an erythema dose.

The radium "collar" is made of five blocks of balsa wood, each block measuring 5 by 3 by 3 cm. The blocks are held together by adhesive plaster. Their proper adjustment to the neck is obtained by pledgets of gauze. The distribution of the radium capsules is shown above. Each brass capsule, of 1 mm. wall thickness, contains 10 to 25 mg. of radium element in standard steel needles, according to indications. The "collar" is strapped in place by adhesive plaster and reinforced by a bandage; 6000 mg-hr. constitutes an erythema dose.

#### RADIUM TECHNIQUE

In the early part of our work we made use of the "block" only. The radium "collar" was a later development. During the first two years of our treatment of toxic goiter we applied the block not only over the lateral lobes of the thyroid but also over the thymus region. When we discovered that a single erythema dose of radium by means of the collar was followed by epilation some 5 to 6 cm. above and below the immediate area of application, we gave up the use of the additional thymus field and confined the treatment to the thyroid region only. The method of treatment consisted in administering one full erythema dose either in one continuous application or in fractionated doses at definitely spaced intervals, usually once every five to seven days. As our experience grew we found that the fractionated dose method in the toxic cases yielded much more satisfactory results than the single massive dose. The spacing of the intervals of treatment and the amount of the fractionated dose given

was entirely gauged by the clinical severity of the case. The more severe the toxic manifestations, the smaller was the initial dose given and the longer the interval of radium application. Generally one-sixth to one-quarter of the erythema dose was given at intervals of five to seven days until a full erythema dose was reached. After each full erythema dose, or course of treatments, an interval of four weeks was allowed. At the end of this time, in addition to a complete clinical restudy a basal metabolic test was done. Guided by the findings the repetition of the dose or course of treatments was planned. On the average a moderately severe case of exophthalmic goiter or toxic adenoma of the thyroid required two erythema doses or courses. Occasionally, however, three or four courses were necessary to effect a complete clinical cure. The cases of juvenile adenoma, as a rule, required less treatment than the toxic cases.

*Nodular Nontoxic, or Simple Adenomatous Goiter.* This group constituted the largest number in our series. The great majority of these patients were above the age of twenty. Very few in this group were given radium therapy. Although some of these treated cases yielded encouraging results, we are not yet prepared to discuss the value and limitation of radium in the treatment of simple adenomas in adults. There were, however, a number of cases of distinctly nodular goiter observed not only in adolescents but also in children below the age of puberty. It is to this juvenile group that we wish to devote our attention in the present communication. The series of cases studied is rather small. Altogether some 20 patients were treated with radium. They deserve, however, the earnest attention of every student of the goiter problem because of immense future possibilities. For, contrary to the usual teachings in the current medical literature, concurred in by a number of prominent radiologists that not all types of nontoxic nodular goiter are amenable to radium and roentgen therapy,

radium therapy in these juvenile patients yielded highly gratifying results.

#### ILLUSTRATIVE CASES

CASE I. A. T., female, aged eleven, was admitted to the Radium Clinic of Beth Israel Hospital in April, 1925, with a history of progressive swelling of the neck since the age of nine. On examination a diffuse and nodular enlargement of the thyroid gland was found. Toxic symptoms were absent. For a period of five months she was kept on iodine medication. At the end of that time the circumference of the neck shrank from 31 to 30 cm., but the nodular mass in the center of the neck became more prominent as the rest of the thyroid gland yielded to the iodine medication. Failing to note any recession of the mass after several months of observation, 2300 mg-hr. of radium with the block at 3 cm. distance was given over the center of the nodular area. This treatment was promptly followed by the disappearance of the mass and shrinkage of the neck to 29 cm.

CASE II. A girl of thirteen was admitted to the Radium Clinic of Beth Israel Hospital in September, 1925, complaining of progressive increase in the size of the neck for the past several months. Examination revealed a diffuse and nodular enlargement of the thyroid gland with predominant involvement of the right lobe. The circumference of the neck through the 7th cervical vertebra and the mid-thyroid region measured 35.5 cm.

Course under iodine treatment. For a period of four months, until February, 1926, she was given moderate doses of compound solution of iodine. Two months later, in April, 1926, the circumference of her neck still measured 35 cm. The nodular or adenomatous mass in the right lobe of the thyroid gland showed no evidence of shrinkage.

Course under radium therapy. Between July 14 and 24, 1926, she was given with the radium block at 3 cm. distance 3000 mg-hr. to the right lobe and a similar dose to the left lobe of the thyroid gland. Gradual and progressive shrinkage of the gland was noted two weeks after the radium treatments were completed. In January, 1927, her general condition was excellent. She had gained 11 pounds in weight while her neck shrank from 35 to 31.5 cm. When last examined in Decem-

ber, 1927, the improvement persisted unchanged.

CASE III. L. W., female, aged thirteen, admitted to the Radium Clinic of Beth Israel Hospital in January, 1928, complaining of swelling of the neck and a choking sensation in the throat for the past two years. For a year prior to admission to the clinic she had been fed small doses of iodine by her family physician, with no effect upon the enlargement in the right side of the neck and only slight shrinkage of the left side. Examination revealed both a diffuse and nodular enlargement of the thyroid gland. The circumference of the neck through the 7th cervical vertebra and the mid-thyroid region measured 31.5 cm.

Diagnosis: Nontoxic nodular, or simple adenomatous goiter.

Course under radium treatment. In February, 1928, she was given over the thyroid region one continuous application of 5165 mg-hr. of radium with the collar at 3 cm. distance. The result was gradual shrinkage of the thyroid adenoma. Ten months later, in December, 1928, the circumference of her neck was reduced from 31.5 to 29 cm., with decided improvement in facial appearance.

CASE IV. (Fig. 3.) F. R., female, aged fourteen, first came to the Radium Clinic in August, 1927, complaining of progressive enlargement of the neck for the past two years and restlessness, nervousness, slight dyspnea and palpitation on exertion for the past two months. Examination revealed a well-nourished and developed young girl with a greatly enlarged and nodular thyroid gland and a basal metabolic rate of plus 12 per cent. Tachycardia, ocular phenomena and tremor were absent.

Diagnosis. Simple adenomatous goiter with beginning toxic symptoms.

Course under iodine medication. For a period of four months she was given moderate doses of compound solution of iodine. This treatment resulted in slow gradual shrinkage of the neck from 38 to 35 cm.

Course under radium treatment. In February, 1928, when we noted that no further shrinkage of the neck was taking place under iodine medication, we decided to resort to the use of radium therapy. This was carried out with the radium collar at 4 cm. distance. During a period of four months thirteen





FIG. 3. Case IV. Adenomatous goiter with mild toxic symptoms in a girl aged fourteen. Before radium treatment.

fractionated doses of radium were given, totaling 10,750 mg-hr. The result was exceedingly gratifying. The circumference of the neck shrank from the original 38 to 32 cm. The result persisting to date is shown in Figure 4.

*Comment.* We consider the above observations demonstrating the beneficial effects of radium therapy in juvenile nontoxic adenomatous goiter of the utmost significance in the management of diseases of the thyroid gland. Nodular nontoxic, or simple adenomatous goiter, as stressed by Aschoff<sup>1</sup> in his recent study of the goiter problem, occurs not only in adults but also in children at birth and proceeds in its biological development in early infancy. Clinically, it becomes detectable in different individuals at different ages. It is this group of nodular nontoxic goiter that yields the bulk of patients that eventually become a serious medical problem either as a result of local disfigurement, compressive phenomena, toxic manifestations or malignancy.



FIG. 4. Case IV. After radium treatment.

It is the knowledge of these facts reemphasized during the course of recent years that has induced a number of prominent surgeons to urge early removal of these simple adenomas as a prophylactic measure against toxic adenoma and cancer of the thyroid gland. That such recommendations are bound to meet with scant success every experienced physician will have to admit. For how many patients with small symptomless adenomas will readily submit to the surgeon's knife? How many parents will be readily induced to permit their children to be operated on for a comparatively small and unobtruding nodule in the neck? Very few, I dare say. Hence, we consider the observation that moderate doses of radium will favorably affect a simple adenomatous goiter in the juvenile as of the utmost significance in the management of diseases of the thyroid gland. From the standpoint of prophylaxis as well as cure, I am confident that the profession will gain a more ready ear from the public when efficient radium therapy rather than



surgery is urged as the method of choice in the treatment of thyroid adenomas in the juvenile.

*Diffuse Toxic, or Exophthalmic Goiter.* The value and place of radium therapy in exophthalmic goiter based upon a review of the literature and my own observations was dealt with in two previous studies.<sup>3,5</sup> Summarized the conclusions were:

Clinical cure of a lasting kind in exophthalmic goiter has been obtained not only by implanting radium interstitially into the thyroid gland but equally well by external applications of properly screened radium. Individualization which is the keynote of life and efficient medical therapy must be strictly observed in the treatment of Graves' disease. The exact dose of radium required to obtain a clinical cure in a case of Graves' disease varies with the individual patient. One to four courses, or erythema doses, may be required. While clinical improvement may be noted within a few weeks after commencement of radium treatment, many months may elapse before the patient is restored to health. To obtain the best results a combination of radium therapy plus rest in bed, proper diet and medication is highly desirable. The great potency of radium as a therapeutic agent in Graves' disease was demonstrated by the numerous case reports from the literature and our own cases which had to be treated in an ambulatory manner and in which no special drug therapy was employed. In spite of its great potency radium therapy properly employed is a safe and convenient agent. In a period of three years of active treatment of cases of Graves' disease by radium not a single one of our patients showed any skin burn, telangiectasis or adhesions to the neighboring structures.

Further observations have corroborated the above statements and are amply illustrated by the following case reports:

CASE V. Miss D. H., aged twenty-seven, was admitted to the Radium Clinic of Beth Israel Hospital in August, 1924, complaining of the following symptoms: hoarseness, insomnia, fatigability, nervousness, irritability, palpitation and tachycardia, weakness, goiter, exophthalmos, poor appetite, diarrhea, urticarial eruptions and loss in weight. Duration of

symptoms four years. Examination revealed a patient with all the classic signs of Graves' disease. Pulse 140 per minute. Basal metabolism plus 63 per cent. The thyroid gland showed a diffuse and irregular enlargement with predominant involvement of the isthmus. The circumference of the neck through the 7th cervical vertebra and the mid-thyroid region measured 38 cm. For nearly four years she had been actively treated medically without any results. Finally, as a last resort, thyroidectomy was urged.

Course under radium treatment. When this patient first came under my personal observation in January, 1925, she had been getting small doses of radium to the thyroid with very slight improvement either in local or general symptoms. We therefore decided to administer larger doses. Between March 27 and May 1, 1925, she was given 5640 mg-hr. of radium in divided doses with the radium block at 3 cm. distance, to the thyroid and thymus regions. The result was prompt improvement in all her symptoms and a decrease in the circumference of the neck from 38 to 34.5 cm. During June and July, 1925, the course of treatments was repeated. This was followed by further improvement in symptoms and a decrease in the size of the neck to 33 cm. Within the next few months she felt perfectly well and was able to resume her professional duties. Reëxamination in the early part of 1929 found her to be in excellent health.

CASE VI. A woman, aged thirty-five, with classic symptoms of Graves' disease, unilateral exophthalmos, barely palpable thyroid gland and basal metabolism of plus 48 per cent was admitted to the Radium Clinic in March, 1925. Duration of symptoms six months.

Course under radium treatment. During April and May, 1925, the patient was given with the block at 3 cm. distance 6000 mg-hr. of radium to the thyroid and thymus regions. The result was prompt improvement in constitutional symptoms. Already in the early part of June she was able to resume her household duties. The heart had slowed down to nearly normal rate and the exophthalmos was receding. One month later, in July, 1925, following an acute nasopharyngeal infection, she developed a recurrence of symptoms. Accordingly, the course of radium treatments



FIG. 5. Case VIII. Severe exophthalmic goiter in a woman aged twenty-eight. Before radium treatment.

was repeated. Again prompt improvement took place. A persistent moderate tachycardia made me repeat the course of treatments towards the end of 1925. In February, 1926, she was free from any evidences of Graves' disease except the persistence of exophthalmos. Reëxamination in November, 1928, found her in excellent health with barely perceptible exophthalmos.

CASE VII. A. E., male, married, aged forty, was admitted to the Radium Clinic in November, 1925, complaining of all the classic symptoms of exophthalmic goiter of two and one-half years' duration. Basal metabolism plus 16 per cent. Blood Wassermann two plus. Circumference of the neck through the 7th cervical vertebra and the mid-thyroid region measured 45 cm.

Course under radium treatment. After the first course of radium treatments to the thyroid and thymus regions given during November and December, 1925, there was prompt and rapid improvement but no complete retrogression of symptoms. Hence, a second course was given in January, 1926. Further improve-



FIG. 6. Case VIII. After radium treatment.

ment followed. Four months later, in May, 1926, he lost all his subjective complaints. The slight persistent tachycardia and thyroid enlargement made me decide to give him a third course of radium therapy. Following this third and last course of treatments the tachycardia gradually diminished, the exophthalmos began to recede and the blood Wassermann became negative without any antiluetic treatment. In March, 1927, the pulse rate was 72, the basal metabolism was normal, the circumference of the neck was reduced from 45 to 38 cm. Reëxamination in the early part of 1929 showed him to be in perfect health.

CASE VIII. (Fig. 5.) Mrs. B. W., aged twenty-eight, first came under observation in May, 1926, complaining of severe symptoms of Graves' disease. Examination revealed marked bilateral exophthalmos. Pulse rate 140 per minute. Basal metabolism plus 62 per cent. Blood pressure: systolic 140, diastolic 40. Thyroid gland diffusely enlarged with predominant involvement of the right lobe. Circumference of the neck through the 7th cervical vertebra and the mid-thyroid region measured 37 cm. Duration of illness nine and a half months.





FIG. 7. Case XII. Severe postoperative exophthalmic goiter in a girl aged fifteen and a half. Before radium treatment.

Course under radium treatment. During June and July, 1926, the patient was given with the block at 3 cm. distance 4500 mg-hr. of radium to the right lobe and 3000 mg-hr. to the left lobe of the thyroid and a similar dose to the thymus region. The result was prompt and striking improvement. Within one month after the treatment was completed she was able to resume all her household duties. The circumference of the neck was reduced from 37 to 34.5 cm. and the basal metabolism dropped from plus 62 to plus 10 per cent. However, the tachycardia persisted and a bruit was still present over the thyroid. Hence, a second course of radium treatments to the thyroid and thymus regions was given in fractionated doses during August and September. Further improvement followed and the exophthalmos began to recede. The circumference of the neck shrank to 33.5 cm. In December, 1926, with subjective complaints entirely absent, she still presented tachycardia and slight thyroid enlargement. Hence, a third course of radium therapy was carried out. The result was exceedingly gratifying. Examination on



FIG. 8. Case XII. After radium treatment.

Feb. 1, 1927, showed complete recovery. The pulse and basal metabolic rate were normal. The circumference of the neck was reduced from the original 37 to 32.5 cm. Her appearance at this time is shown in Figure 6.

Towards the end of 1927 she gave birth to a healthy child. Four months later mother and baby were examined and were found free from any evidence of thyroid disturbance. Reëxamination in the early part of 1929 found her in excellent health with a gain of 40 pounds in weight and no symptoms of Graves' disease.

CASE IX. A young woman, aged twenty, having a moderately severe case of Graves' disease, first consulted me in August, 1926. Following one erythema dose of high voltage roentgen therapy to each lateral lobe of the thyroid and to the thymus regions there was temporary improvement with prompt relapse. She was then treated with radium over the thyroid and thymus regions. The result was slow and gradual improvement. In May, 1927, eight months after radium therapy was started, her pulse came down to 72 per minute. The basal metabolism dropped from plus 25 per cent to normal rate. The circumference of

the neck was reduced from 37 to 33.5 cm., while her weight rose from 135 to 150 pounds.

She remained entirely free from any evidence of Graves' disease until the end of 1928. At this time, following an operation for a large ovarian cyst, she developed a recrudescence of her symptoms. These yielded promptly to further therapy. When last heard from in April, 1929, she was feeling well and had no toxic symptoms during the early months of pregnancy.

CASE X. B. W., female, aged twenty-six, married, seen for the first time in June, 1926, had a severe case of Graves' disease with a basal metabolic rate of plus 52 per cent. After two courses of radium treatments directed to the thyroid and thymus regions she made a fairly rapid and complete recovery and has remained well to date. Of additional interest in her case is the observation that large diseased tonsils from which she had been suffering for a number of years became completely atrophied as an incidental result of the radium therapy directed towards the thyroid region only.

CASE XI. Mrs. F. K., aged twenty-eight, a moderately severe case of Graves' disease of two years' duration, had been treated medically without any appreciable improvement. Operative intervention, repeatedly urged by the attending physicians, was invariably refused by the patient. Under radium therapy she made a satisfactory recovery. Last examination in the early part of 1929 found her entirely free from complaints and attending to all her duties. The thyroid gland was not palpable. The circumference of the neck was reduced from 34 to 30.5 cm. The exophthalmos had completely receded.

CASE XII. (Fig. 7.) F. K., female, aged fifteen and a half, a severe postoperative case of exophthalmic goiter, first came under my observation in June, 1926. Four months after operation, with a marked drop from the previously high basal metabolic rate to nearly normal level, her clinical symptoms showed only slight recession. What radium treatments accomplished for this patient is shown in Figure 8, namely complete restoration to health. The last examination in April, 1929, failed to show any evidence of recurrence of symptoms.

CASE XIII. B. W., female, aged thirteen, a classic case of exophthalmic goiter, was seen for

the first time in August, 1927. The duration of symptoms was ten months, unrelieved by medical treatment. Thyroidectomy urged by the family physician was refused by the parents. Following two courses of radium therapy she made a prompt and complete recovery and has remained well since.

CASE XIV. (Fig. 9.) Female, aged twenty-seven, one of the most severe cases of Graves' disease unrelieved by prolonged rest in bed and medical treatment, came under my observation in February, 1928. Duration of symptoms two years; complete disability one year.

Course under radium treatment. What radium therapy accomplished for this patient can be seen in Figure 10. Examination in October, 1928, failed to show any evidence of exophthalmos. The basal metabolism had dropped to normal from its initial 63 per cent and the pulse varied between 63 and 72 per minute. Nevertheless, in spite of apparently complete objective cure which was achieved by three courses of radium therapy, she still complained of slight fatigability on exertion. After further small fractionated doses of radium she gradually lost her residual complaints and in March, 1929, was able to resume the practice of her nursing profession.

CASE XV. L. P., female, aged twenty-one, a moderately severe case of exophthalmic goiter of three years' duration, unrelieved by medical treatment, was first seen in March, 1928. Following the first course of radium therapy to the thyroid region there was improvement in constitutional symptoms, a gain of 10 pounds in weight and a drop in basal metabolism from plus 36 to plus 25 per cent. The exophthalmos, however, became more prominent. Under two more courses of radium treatments her symptoms receded almost entirely, the basal metabolism became normal and the exophthalmos was barely noticeable. When last seen in January, 1929, she still complained of slight fatigability and tachycardia on exertion. Objective examination elicited but few traces of active Graves' disease. Abdominal palpation revealed moderate tenderness in the right iliac fossa. Careful questioning then elicited a history of recurrent attacks of abdominal cramps and digestive disturbances strongly suggestive of appendicial disease. Surgical consultation was urged, but





FIG. 9. Case XIV. Severe exophthalmic goiter in a woman aged twenty-seven.

the patient declared she felt too well to consider operative intervention for the present.

CASE XVI. M. D., female, aged forty, was seen in consultation in August, 1928. Chief complaints, irritability, emotionalism, lachrymose condition, weakness, loss in weight, tachycardia and palpitation, goiter, exophthalmos and tremor. Duration of symptoms fifteen months. Examination revealed a diffuse enlargement of the thyroid gland with marked vascularity. The circumference of the neck through the 7th cervical vertebra and the mid-thyroid region measured 33.5 cm. Basal metabolism plus 62 per cent.

Course under radium treatment. Following the first course of radium treatments with the collar at 3 cm. distance there occurred prompt and decided improvement in all symptoms and a drop in basal metabolism from plus 62 to plus 25 per cent. Complete clinical cure was achieved after the second course of radium therapy which was carried out in November and December, 1928. In January, 1929, the basal metabolism dropped to normal. The patient became free of all her complaints.



FIG. 10. Case XIV. After radium treatment.

Indeed, she declared she had not enjoyed such excellent health in many years.

CASE XVII. Female, aged forty-four, married, had a severe case of Graves' disease of three years' duration. Examination revealed a diffuse and nodular enlargement of the thyroid gland with marked vascularity. Basal metabolic determination in the early part of August, 1928, showed plus 70 per cent. The blood pressure registered 170 systolic and 70 diastolic. Pulse rate 140 per minute.

Course under radium treatment. Prompt and marked improvement was noted after one erythema dose of radium with the radium collar at 3 cm. distance, given to the thyroid region. Complete clinical cure occurred after the second erythema dose. She gained 30 pounds in weight. The neck shrank from the original 35.5 to 34 cm. The basal metabolism dropped to normal. The systolic pressure came down from 170 to 140 and the diastolic pressure rose from 70 to 80.

CASE XVIII. This case is recorded to emphasize the fact that both surgery and radium therapy may fail to achieve a complete clinical cure in long standing cases of Graves' disease. This patient first came under my observation in February, 1925, several months after she



had undergone bipolar ligation, right cervical sympathectomy and thyroidectomy for a severe form of exophthalmic goiter treated medically without success for a period of three years.



FIG. 11. Case XVIII. A case of postoperative Graves' disease with persistent exophthalmos.

When first examined by me, in spite of a normal basal metabolic rate and marked gain in weight, she had a number of complaints usually associated with active Graves' disease. Although these symptoms were partially relieved by very small doses of radium the exophthalmos, as shown in Figure 11, fails to show any recession, nor has there been any recession since.

*Comment.* Undue delay in the local treatment of toxic goiter is undesirable. Although highly favorable results from radium therapy in Graves' disease have been obtained, even in severe and long standing cases, much better results are obtained in the earlier stages of the disease. To obtain a clinical cure in Graves' disease by radium therapy one or more courses may be required. Hence the patient is to be frankly told at the outset that the treatments may have to extend over a period of several months to a year and that several courses of treatment may have to be given before complete cure is achieved. Unless these facts are stressed and the patient's

cooperation obtained many a potentially successful case will drop out before radium therapy has had a fair trial and will be registered as a failure of radium treatment per se, when more prolonged or adequate dosage would have resulted in the excellent clinical cures demonstrated in the series of cases presented above.

*Nodular Toxic, or Toxic Adenomatous Goiter.* This subject was dealt with comprehensively in a recent study.<sup>4</sup> Summarized, the conclusions were:

Neither clinically nor pathologically is there any fundamental distinction between toxic adenoma and exophthalmic goiter except as the variation of a single disease. Eponymically, Parry's disease—and not Basedow's or Graves' disease—is the most appropriate designation for toxic adenoma and exophthalmic goiter, for Parry is the first observer who described all varieties of toxic goiter. Clinically, a nodular goiter without exophthalmos may be as toxic or even more toxic than a smooth, diffusely enlarged or exophthalmic goiter with pronounced ocular signs. The prognosis in a severe case of toxic adenoma with myocardial insufficiency is much graver than in a moderately severe case of classic exophthalmic goiter with markedly bulging eyes and a myocardium fairly intact. Although toxic adenoma may run as severe a course as exophthalmic goiter, its clinical manifestations are usually milder and the surgical results more satisfactory than in classic exophthalmic goiter. The more favorable surgical results in toxic adenoma are not due to any fundamental difference in nature from exophthalmic goiter but to a variation of a single disease: In exophthalmic goiter the entire gland is usually involved in an individual who previously apparently was free from thyroid disease, while in toxic adenoma the thyroid gland shows one or more areas of involvement in a pathologic process with intervening healthy tissue between the affected areas. Hence the symptoms are usually milder and the surgical results more satisfactory than in diffuse hyperplastic or exophthalmic goiter. Surgery, however, is not the only means of successful treatment of toxic adenoma of the thyroid. All the various medical measures that have been found helpful in the management of classic exophthalmic goiter are of equal use in

toxic adenoma. Of the local agents contending for the most efficient modern treatment of toxic adenoma surgery has been recognized until the present day by the majority of the medical profession as the method of choice while röntgen and radium therapy have been disregarded. A review of the literature and our own case reports stress the fact: Surgery is no longer the only local means of relief in dealing with toxic adenoma of the thyroid. Radium therapy, efficiently used, relieves not only the toxic but also the compression phenomena in toxic adenoma of the thyroid. Radium therapy, safe, efficient, free from surgical mortality, ought to become henceforth the method of choice in dealing not only with exophthalmic goiter but also toxic adenoma of the thyroid.

CASE XIX. J. B., male, aged seventy-five, had had symptoms of thyrotoxicosis for five years. Examination revealed two large adenomas in the lateral lobes of the thyroid gland. The circumference of the neck measured 40 cm. Tachycardia was moderate with distinct auricular fibrillation. Basal metabolism plus 25 per cent.

Course under radium treatment. During the summer of 1925 the patient was given 6200 mg-hr. of radium with the block at 3 cm. distance over the adenomas and thymus region. Only one course of treatments in fractionated doses was given. Four months after treatment the thyrotoxic symptoms disappeared, including the auricular fibrillation. The basal metabolism dropped to normal. He gained several pounds in weight while the circumference of the neck was reduced from 40 to 35 cm.

*Comment.* Before coming under my observation, this patient was advised against operation on account of his advanced age and poor general condition. He was told he had better "let nature take its course." The result achieved by radium therapy in his case is an excellent demonstration that surgery is no longer the only method in dealing with toxic adenoma of the thyroid and that it is no longer necessary to "let nature take its course" in dealing with poor-surgical-risk cases of toxic adenoma of the thyroid. The last examination of this patient in April, 1929, found this man of eighty, five years after admission to the

Radium Clinic of Beth Israel Hospital, in excellent health.

CASE XX. Female, aged fifty, with a partly retrosternal toxic adenoma of the thyroid was seen for the first time in March, 1926. Duration of moderately severe toxic symptoms, five years. Circumference of the neck 35.5 cm.

Course under radium treatment. Following three courses of radium therapy given during 1926 and 1927 the thyrotoxic symptoms were relieved and the circumference of the neck shrank from 35.5 to 31.5 cm. while her weight rose 11 pounds. Reëxamination in the early part of 1929 found her in good health and attending to all her domestic duties.

CASE XXI. Y. K., female, aged forty-eight, a case of postoperative recurrent toxic adenoma of the thyroid with mediastinal compression phenomena, first came under my observation in December, 1926. For one year she had been suffering from moderately severe toxic symptoms unrelieved by medical and several low voltage roentgen treatments. Examination revealed a diffuse and nodular enlargement of the thyroid gland with dilatation of veins over the lower anterior neck and upper chest. The circumference of the neck measured 34.5 cm. Basal metabolism plus 58 per cent.

Course under radium treatment. After two erythema doses of radium with the collar at 3 cm. distance, giving during the Spring and Summer of 1927, there was marked improvement in constitutional symptoms. The basal metabolism dropped from plus 58 to plus 6 per cent. Her weight rose from 118 to 129 pounds, while her neck shrank from 34.5 to 32.5 cm., with disappearance of the dilated veins over neck and thorax.

CASE XXII. Female, aged twenty-eight, married, first applied to the Radium Clinic of Beth Israel Hospital in February, 1927. Duration of mild toxic symptoms for nearly eight years, severe toxic symptoms for three months. Basal metabolism plus 52 per cent. Circumference of the neck through the 7th cervical vertebra and the mid-thyroid region measured 36 cm.

Course under radium therapy. Four months after a single dose of 6000 mg-hr. of radium administered during a period of five days she lost all her subjective complaints. Her pulse came down to 72 per minute. The basal metabo-



lism became normal. She gained considerably in weight. Her neck shrank from 36 to 33 cm. No recurrence of symptoms three years later.

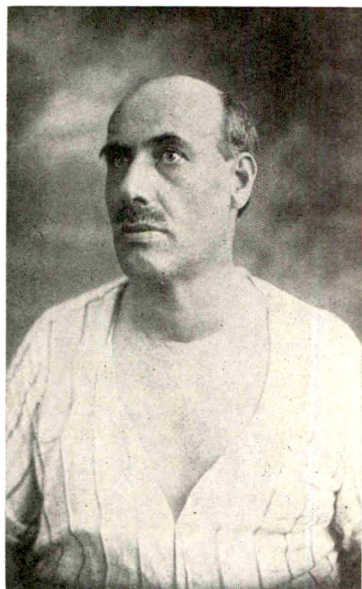


FIG. 12. Case xxiv. Severe postoperative toxic adenoma of thyroid in a man aged fifty.

CASE XXIII. B. O., female, aged thirty-two, married, suffering from thyrotoxic symptoms with marked mental manifestations recurring in attacks. Examination revealed a nodular enlargement of the thyroid gland. Circumference of the neck through the 7th cervical vertebra and the mid-thyroid region measured 33 cm. Moderate tachycardia. Basal metabolism plus 30 per cent.

Course under radium treatment. Within three weeks after a single erythema dose of 6000 mg-hr. of radium with the collar at 3 cm. distance, there was marked improvement in constitutional symptoms and a decided change in facial expression. The melancholic look was gone. She felt more cheerful. Her strength improved greatly. Her pulse dropped to 72 per minute. The basal metabolism became normal. She gained several pounds in weight. The circumference of the neck was reduced from 33 to 30.5 cm. No recurrence of symptoms since.

CASE XXIV. (Fig. 12.) Male, aged fifty, with severe postoperative toxic adenoma of the thyroid. Six months after partial thyroidectomy all the thyrotoxic symptoms persisted

unabated. During the fall of 1927 he was given three courses of radium treatments. There was only slight relief and the patient became fretful at the slow improvement noted. Hence, with-

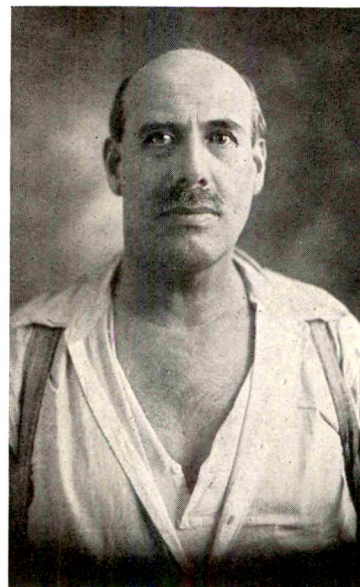


FIG. 13. Case xxiv. After radium therapy and reoperation.

out even waiting for the erythematous reaction from the third radium treatment to subside, he went to the Cleveland Clinic to obtain a quick cure by further surgery. The operation, subtotal thyroidectomy, was performed by Dr. G. W. Crile in December, 1927. The patient returned to New York in January, 1928, and remained under my constant observation for one year. In spite of subtotal thyroidectomy he still presented toxic symptoms and was unable to resume his work in July, 1928, or nearly seven months after the second operation.

*Comment.* The clinical behavior of this case serves to emphasize the following two important lessons: (1) A severe case of toxic adenoma of the thyroid may be very resistant to all forms of treatment—irradiation as well as operation. (2) Radium therapy properly carried out does not make subsequent operation on the thyroid a more difficult task even in a case previously thyroidectomized. The cosmetic result after radium and reoperation is shown in Figure 13.



*Malignant, or Cancerous Goiter.*

CASE XXV. H. S., male, aged forty-four, first came under my care in July, 1923. For a period of five years, until the end of 1922, he had a progressive enlargement of the neck which on repeated medical consultations was diagnosed benign goiter. In December, 1922, he suddenly developed a pathologic fracture of a rib. But even this significant lesion failed to stir any suspicion in the minds of the attending and consulting physicians about the possible malignant character of the thyroid growth. Only many months later, in 1923, when he developed hemoptysis, did roentgen examination of the chest lead to the discovery of a tumor mass at the site of the pathologic fracture. The biopsy of this tumor diagnosed as round and spindle cell sarcoma raised for the first time the question of a possible relation between the thyroid growth and the bone tumor. Further roentgen studies revealed extensive skeletal metastases. One of these metastatic lesions in the skull led to complete destruction of the bone with perforation to the dura, yielding an impulse on coughing. Under radium treatment the bone defect in the skull closed completely. New bone formed at the site of destruction. The other metastatic areas in the skeleton were kept almost completely in check the next four years by roentgen therapy. The thyroid gland, the carcinomatous nature of which was revealed by further biopsy, shrank under the therapeutic effects of radium and roentgen therapy. The patient finally succumbed to brain metastases in 1927, ten years after the thyroid tumor had first been discovered and four years after extensive skeletal metastases had been revealed on roentgen examination.

*Comment.* The history of this patient, which recounts the usual clinical behavior of thyroid malignant growths, emphasizes the following important lessons:

1. Malignant tumors of the thyroid gland may grow progressively for a period of five years and more without causing any pressure phenomena, invasive growth or impairment of general health.

2. The first evidence that apparently a "simple adenoma" is merely a slowly growing malignant thyroid tumor may be dis-

closed by the appearance of metastases in the bones, lungs or other organs.

3. The current belief in medical circles that 90 per cent or more of thyroid cancer develops on the basis of preëxisting simple adenoma may or may not be correct. The observation, however, that for many years a thyroid cancer may be indistinguishable in its clinical characteristics and behavior from a simple adenoma, is a well-established fact.

4. Already in the so-called early stage of thyroid cancer frequent metastases occur in the skeleton and other organs.

5. The great difficulty, if not impossibility, of clinically diagnosing thyroid cancer in its local stage before general dissemination has occurred, renders every form of therapy directed to the thyroid region only of mere palliative value. This applies not only to surgery, radical or otherwise, but applies equally to radium and roentgen therapy.

6. A careful review of the literature shows that radical surgery has failed to produce permanent cure of thyroid cancer even when operated on in the so-called early stage of the disease.

7. The surgical mortality in definitely diagnosed thyroid cancer runs very high. It was no less than 25 per cent at Crile's Clinic<sup>10</sup> and 30 to 66 per cent in some of the European clinics.<sup>12</sup> Hence surgical extirpation can only have its appeal in the absence of any other superior method.

8. Radium and roentgen therapy efficiently employed have given superior results to operation in the treatment of primary and metastatic malignant thyroid tumors, as shown in the reports of Klose and Hellwig,<sup>8</sup> Schaedel,<sup>11</sup> Përthes,<sup>9</sup> Holfelder,<sup>6</sup> Holzknecht,<sup>7</sup> Portmann,<sup>10</sup> Bowing,<sup>2</sup> and others. The two most interesting reports come from the Mayo<sup>2,13</sup> and Crile clinics. These are briefly summarized in Tables I and II. The observation at both these clinics that a combination of operation plus irradiation is superior to any single method is highly interesting and

TABLE I  
(Modified after Portmann<sup>10</sup>)  
RADIATION THERAPY IN MALIGNANT DISEASE OF THE  
THYROID GLAND  
Comparative Summary of Results of Treatment of Malignant  
Growths of Thyroid

	Total Cases	No Trace	Operative Mortality	Dead 1-5 Years	Alive 1-5 Years
Operation only	44	7 15.9%	11 25%	18 40.8%	8 18.1%
Radiation only	28	5 18%	1 3.6%	13 46.4%	10 37.8%
Operation plus radiation	53	8 13.2%	1 1.8%	16 27.2%	29 52.4%

TABLE II  
(Modified after Wilson<sup>11</sup> and Bowing<sup>2</sup>)  
RADIATION THERAPY IN MALIGNANT DISEASE OF THE  
THYROID GLAND  
Comparative Summary of Results of Treatment of Malignant  
Growths of the Thyroid

	Total Cases	No Trace	Operative Mortality	Average Duration of Life
Operation only (Wilson)	207	13	?	18 months
Radiation only (Bowing)	76	5	?	21 months
Operation plus radiation	91	4	?	45 months

instructive. This observation would have been even more instructive had the authors given us an insight as to why this combination proved superior to the single use of either one of these methods. However, even in the absence of any such information concerning the relative share each agent contributed to these superior results, the value and place of irradiation in the treatment of thyroid cancer is thus forcibly brought to light.

#### SUMMARY AND CONCLUSIONS

In a series of some 500 goiter patients studied intensively during the years 1922 to 1928 the following five groups were encountered: (1) Diffuse nontoxic, or simple goiter; (2) nodular nontoxic, or simple adenomatous goiter; (3) nodular toxic, or toxic adenomatous goiter; (4) diffuse toxic, or exophthalmic goiter, and (5) malignant, or cancerous goiter.

Group 1 was treated entirely by general medical measures plus iodides and was not subjected to radium therapy.

Patients with simple adenomatous goiter were classified into two types: (a) juvenile; (b) adult. Only the juvenile group was dealt with in the present communication. These juvenile patients showed very encouraging results from radium therapy.

In exophthalmic goiter clinical cure of a lasting kind has been obtained not only by implanting radium interstitially into the thyroid gland but also by external application of properly screened radium.

Neither clinically nor pathologically is there any fundamental distinction between a toxic nodular goiter—toxic adenomatous goiter—and diffuse toxic goiter—exophthalmic goiter—except as the variation of a single disease. In exophthalmic goiter the entire gland is usually involved in an individual who previously was apparently free from thyroid disease, while in toxic adenomatous goiter the thyroid gland shows one or more areas of involvement in a pathologic process with intervening healthy tissue between the affected areas. Hence the symptoms are usually milder and the surgical results more satisfactory than in diffuse hyperplastic or exophthalmic goiter. Surgery, however, is not the only local means in the successful treatment of toxic adenomatous goiter. Radium therapy, efficiently used, relieves not only the toxic but also the compression phenomena in toxic adenomatous goiter, or toxic adenoma of the thyroid.

Early clinical diagnosis of cancer of the thyroid before general dissemination has occurred, is extremely difficult, if not impossible.

Radical surgery has failed to produce permanent cure of thyroid cancer even when the operation was performed in the so-called early stage of the disease. Hence radical surgery with its extremely high mortality is only of palliative value in definitely diagnosed thyroid cancer.

The end-results of surgery in thyroid cancer would only justify the method in the absence of any superior method.

Radium and roentgen therapy efficiently

employed has yielded results superior to operation in the treatment of primary and metastatic thyroid cancer.

The observation in some clinics that a combination of operation plus irradiation

has given better results than the single use of either method requires further study. Nevertheless, the great value and place of irradiation in the treatment of thyroid cancer is thus definitely established.

## REFERENCES

1. ASCHOFF, L. The Goiter Problem. Lectures on Pathology. Paul B. Hoeber, New York, 1924, pp. 313-339.
2. BOWING, H. H. Malignant tumors of the thyroid gland treated by operation, radium and roentgen rays. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1927, 18, 501-508.
3. GINSBURG, S. Thyrotoxicosis in childhood; early diagnosis and radium therapy. *Am. J. Dis. Child.*, 1929, 37, 923-943.
4. GINSBURG, S. Toxic adenoma of thyroid. *Arch. Int. Med.*, 1929, 44, 73-117.
5. GINSBURG, S. Radium treatment of exophthalmic goiter. To be published.
6. HOLFELDER, H. Die Erfahrungen mit der Röntgentherapie der malignen Tumoren an der Schmiedenschen Klinik. *Strahlentherapie*, 1923, 15, 715-731.
7. HOLZKNECHT, G. Schilddrüsen Karzinom und Röntgenbestrahlung. *Wien. klin. Wchnschr.*, 1924, 37, 419-420.
8. KLOSE, H., and HELLWIG, A. Die Struma maligna. *Klin. Wchnschr.*, 1922, 1, 1687-1691.
9. PERTHES, J. Zur Biologie und Klinik der Röntgentherapie der chirurgischen Krebse. *Strahlentherapie*, 1923, 15, 695-714.
10. PORTMANN, U. V. Radiation therapy in malignant diseases of the thyroid gland. *J. Am. M. Ass.*, 1927, 89, 1131-1135.
11. SCHAEDEL, W. Ueber Struma maligna. *München. med. Wchnschr.*, 1922, 69, 1282-1285.
12. SUDECK, F. Ueber die Behandlung des Morbus Basedowii und der Struma maligna mit Röntgenstrahlen. *Deutsche med. Wchnschr.*, 1918, 44, 1104-1105.
13. WILSON, L. B. Malignant tumors of thyroid. *Ann. Surg.*, 1921, 74, 129.

## DISCUSSION ON PAPERS OF DRS. LOUCKS AND GINSBURG

DR. HENRY J. ULLMANN, Santa Barbara, Calif. A few weeks ago I saw an abstract of a German article in which a warning was given against using Lugol's solution before irradiation, and I wish to ask each of the essayists his opinion on this.

One very important point not discussed in either of these papers, but which receives much attention among my colleagues at home, pertains to the selection of surgery, which can be performed at once, or irradiation, which requires six months to a year before the patient receives the full benefit of treatment. In a case of hyperthyroidism with marked toxic changes and in which it is important to get immediate relief from toxicity, a good internist and a good goiter surgeon both believe that there is little difference in the ultimate results between surgery and irradiation and that the mortality from surgery is no greater than that from an overloaded heart during the time required for irradiation.

I was much interested in Dr. Ginsburg's treatment of the simple, nodular, juvenile adenoma, because I felt, as most physicians do, that the treatment of simple goiter in the child

by irradiation is a risky procedure. I judged from Dr. Ginsburg's report that it is not. I noticed from the illustrations that many of the patients did not show complete retrogression of the exophthalmos. I believe that it is always wise to warn patients that while we expect to relieve the toxic condition, we cannot offer any definite prognosis in regard to the exophthalmos. I am using the roentgen ray instead of radium because it happens to be a little easier for me as my radium is apt to be in use in the treatment of malignant cases, but I use high voltage with copper filter. A month or two ago a patient to whom I had given several treatments of short wave radiation received one treatment with an equivalent dose of low voltage, aluminum filtered roentgen rays. There was much more reaction from this than from the heavily filtered treatment, and I returned to the latter with the original absence of reaction. I start with a small dose if there is much toxicity and treat every day or two until I have given my full dose which is 700 r, including back-scattering, and allow for 7 per cent per day loss.

We must bear in mind that a patient may

have a pulse of from 100 to 120, be nervous and high strung but without tremor and with clinically a definite mild hyperthyroidism, but with a basal metabolic rate of  $-20$ . Such a patient of mine had had the ovarian function modified by radium treatment for uterine fibroids. She was given one-quarter grain of thyroid extract three times a day. The basal rate came up to normal, the nervousness disappeared and the pulse dropped to below 90. I discussed this case with Dr. Engelbach of St. Louis and he told me that he had observed such a syndrome and thought it was due to an imbalance between the ovary and the thyroid. It is, therefore, probably a lowered ovarian function giving hyperthyroid symptoms with an actually lowered thyroid function.

With regard to the eczema of the ears spoken of by Dr. Ginsburg, one must consider the possibility that the change in metabolic rate had as much to do with the cure of eczema as the irradiation. Either one will effect eczema. I have many cases only slightly improved by irradiation, who give suggestive histories of protein sensitization, and whose eczemas cleared up nicely on giving enteric coated pancreatin over a period of a month or more.

DR. G. ALLEN ROBINSON, New York City. My experience with a considerable number of these patients has not been entirely pleasing, because of the difficulty in reducing the size of the thyroid. Even though patients are told that their necks will not go back to normal, still they expect it. Again I have seen skin changes in some of the cases, and even with moderate doses of radium. I think if Dr. Ginsburg has not seen this he will. It is disfiguring to say the least, and whether or not a smooth scar is preferable to these changes is for the profession to decide. It seems to me that surgery in the thyroid has been so uniformly successful that with the pitfalls and difficulties in reducing the tumor mass with radium, irradiation may not be the treatment of choice. In the treatment of malignancy of the thyroid I think we have all obtained excellent results by a combination of surgery and radium.

DR. G. W. GRIER, Pittsburgh, Pa. I would like to ask Dr. Ginsburg whether in the treatment of the little girls time enough has elapsed to know whether there has been any influence

on puberty, or the development of the children.

DR. H. H. BOWING, Rochester, Minn. I wish to discuss Dr. Ginsburg's paper and especially refer to the combined method of treatment of carcinoma of the thyroid gland. As a rule, the pathology encountered in malignant disease of the thyroid gland makes the combined methods necessary. For example, in one type of malignant disease of the thyroid gland, the tumor is very cellular and it is astonishing to see what effects may be produced and to what degree palliation will occur with the application of radium surface packs; however, when necrosis is present surgery is indicated. Further, a papillary carcinoma of the thyroid gland is usually of a low grade malignancy and in some cases, becomes cystic in areas. In this event a combination of surgery and irradiation seems indicated. Palpation of the thyroid tumor field may elicit these areas of necrosis and cystic change and thus determine the best procedure to employ for the case under consideration.

DR. LOUCKS (closing). Regarding Lugol's solution, this is valuable but dangerous, as I mentioned. It should not be given in any kind of a goiter for more than ten days or two weeks. It should not be given during irradiation. There is an activity of the thyroid gland at the time of irradiation and Lugol's solution makes the condition worse.

The bad cases of toxic thyroid, with a high metabolic rate, high pulse, and all the other symptoms given by Dr. Ginsburg, are bad surgical risks and men with a good surgical reputation, such as Crile and the Mayos I think would not operate in those cases. They start to respond within six months to irradiation and it takes that long for surgery to give full results, or longer.

It would take too long to go over my complete technique. I have not changed it, except that I use varying amounts of radium—never less than 100 mg.; never more than 180 mg. With my technique I can place the radium over the tumor, or can give it substernally. Your clinical experience will tell you whether one side needs more irradiation than the other. Some cases need 1200 mg-hr. and some will need only 800 mg-hr., for either side.

The differentiation between a functional activity and a toxic thyroid is the great point.



As I mentioned in my paper, physiological activation may come from many things, an automobile accident, shock of any kind, influenza, etc. If the patients are given rest treatment, an ice collar, forced feeding, and Donovan's solution, which contains a small quantity of iodine, they improve. This solution should be given for three weeks and then they should rest for three weeks without it. Very little medication is required at any time with the treatment. Many times we have to carry a patient along with digitalis, luminal or something to give them an appetite, or there may be an acidosis which requires treatment.

DR. GINSBURG (closing). For a more detailed discussion of the association of increased pulse rate and minus metabolic rate in patients with Graves' disease, I wish to refer Dr. Ullmann to my paper on "Thyrotoxicosis in Childhood; Early Diagnosis and Radium Therapy," which appeared in the *American Journal of Diseases of Children* in May, 1929. Here I briefly wish to state that in several cases of classic Graves' disease I have observed the association of a minus basal metabolic rate with increased pulse rate and other toxic manifestations of the disease. In a recently studied case of exophthalmic goiter with very high basal metabolism the rate dropped to minus 20 per cent after deep roentgen therapy. But the tachycardia and many of the toxic symptoms persisted in spite of the lower basal metabolic rate. Moreover, the observations of Plummer, Kessel, Jackson, and others, that the administration of thyroxin to patients with severe thyroid crisis instead of aggravation may cause marked amelioration of the thyrotoxic symptoms and actually prove life-saving,

strongly militate against the current popular theory that Graves' disease is almost invariably synonymous with hyperthyroidism. Regarding eczema of the ears which cleared up after radium therapy directed to the thyroid, the result may have been coincidental or secondary to general improvement. However, my repeated observation that following radium therapy to the thyroid region many a large tonsil had shrunk considerably in size, appears to justify the belief in this case that the eczema probably cleared up as the result of the radium rays, the potency of which extended beyond the immediate area of application.

As to the late scarring which Dr. Robinson is afraid of, I wish to assure him that the technique outlined in my paper is a perfectly safe method of treatment. I have followed my patients from one to four and a half years and have observed no scarring. That mild telangiectasis may occasionally occur, I shall not dispute. Thus far, however, the results from this technique have been very gratifying.

In reply to Dr. Grier's question, I wish to state that the number of children treated to date has been about twenty. In these I have not noticed any subsequent abnormality either in physical or mental development. Moreover, if we consider the percentage depth dose at 2 or 3 cm. from the skin surface which, according to the calculations of Dr. Schwartzchild, the physicist at the Beth Israel Hospital, averages between 40 and 50 per cent of the skin erythema dose, we need have no fear that the technique used will completely destroy the thyroid in these juvenile patients and be followed by myxedema and hypovarian function.



# BARIUM ENEMA ENTERING ESOPHAGUS\*

## CASE REPORT

By CLINTON G. LYONS, M.D.

*Roentgenologist, United States Veterans' Bureau Hospital*

HINES, ILLINOIS

THE following case is reported primarily because of the exceeding rarity of the condition. A search through modern textbooks and literature fails to reveal a similar case recorded.

Male, aged thirty-five, white, married; occupation, coal miner.

*Family History.* Mother and father living and well. One brother and two sisters living and well. One sister died at age of fourteen with goiter. Patient has 3 children. No trace of insanity, cancer or tuberculosis.

*Personal History.* Patient had ordinary childhood diseases. Received broken leg (left) when about three or four years old. Had typhoid fever at age of fourteen. Patient states he has had stomach trouble since date of entering the Army. Was a patient in Hospital No. 35, St. Louis, Mo., for two months in 1923, and was treated for duodenal ulcer. In Hospital No. 67, Kansas City, Mo. for three months, 1925, received treatment and operation for duodenal ulcer. In Hospital No. 67, Kansas City, for three months in 1928, treatment for duodenal ulcer. Patient states that operation for duodenal ulcer was performed at St. Joseph's Hospital, Ottumwa, Iowa, in 1925. Tonsils removed at Hospital No. 67, Kansas City, in 1928. Smokes cigarettes, does not use drugs or alcohol. Denies any venereal disease.

*Military History.* Enlisted May 28, 1918, Camp Dodge, Iowa. Assigned to Co. H, 349th Inf. Overseas for nine months. Was treated for stomach trouble for three weeks in a hospital in France. Had light attack of influenza in France. No other illness or injury in service. Discharged Camp Dodge, Iowa, June 11, 1919.

*Present Illness.* Has had stomach trouble for past eleven years. Onset gradual with pain one hour or more after meals, relieved temporarily by taking food. Had gastroenterostomy in 1925, and has not had pain since then. Has vomited and had diarrhea for the past three years, blood in stools on several occasions from

tarry consistency to bright red; belches a great deal and has gas in bowels. Vomitus and gas belched have very foul odor.

*Chief Complaint.* On admission—vomiting, diarrhea, loss of weight, weakness.

*Physical examination,* Oct. 24, 1929, revealed an emaciated white male, acutely ill. Height and weight not taken. The skin appeared dry. There was a scar in the upper right abdominal quadrant which was well healed. The eyes were negative, pupils normal. Three teeth were missing, caries of one tooth, and salivary deposits. The chest was of medium length, narrow, flat, musculature poor, expansion poor and equal. The lungs were normal, heart, normal; pulse, 104; blood pressure, 110/70. The abdomen showed tenderness in the epigastrium to the right of the midline; no rigidity or masses felt. There was edema of the scrotum and a pitting edema of lower extremity. No enlargements were noted in the glandular system. Examination of the reflexes showed the knee joints sluggish.

A diagnosis of gastrocolic fistula and secondary anemia was made.

*Surgical Consultation:*—

*History.* Patient's chief complaint is vomiting, loss of weight, and diarrhea, which has been present for at least two years, but much worse during the last few months. The vomitus is frequently fecal in type and he states that the food that he has eaten passes right through within a short time and many particles of it can be recognized in the stools. He has no pain. Occasionally his stools are tarry-like. He had a gastroenterostomy in 1925.

*Examination.* Patient is emaciated, anemic, and there is a pitting edema of both legs and perhaps slightly of one hand. The abdomen is flat and soft throughout. There is an upper right rectus operative scar. There is some tenderness in the epigastrium.

*Laboratory Findings.* Urinalysis, negative; Wassermann and Kahn reactions, negative; blood examination: Hb., 70 per cent; red blood cells, 3,500,000; white blood cells,

\* Published by authority of Dr. Winthrop Adams, Medical Director, United States Veterans' Bureau.

11,800; polymorphonuclears, 88 per cent; small and large lymphocytes, 12 per cent. Examination of feces negative.

*Roentgen Findings.*

**Roentgenoscopic Examination:** Opaque enema filled rectum and sigmoid to a ballooning. The head of the barium column pursued a central vertical climb to a proximal distance of 15 cm., looping downward and outward to the left lower quadrant of the abdomen, where many loops were formed with slight ballooning, causing the patient to complain of distress. The head of the column took a high and rapid climb from this region to the splenic flexure. At this point the colon was ballooned throughout and the contents of the enema can was exhausted. With additional barium the opaque enema caused distention of the splenic flexure and many small streams of barium were seen extending downward and inward, crossing the abdomen in various directions, attributed to barium entering and filling the convolutions of the small intestine. A column of barium was observed in an upward climb entering and filling the stomach through a gastroenterostomy. The barium meal was also visualized in the lower third and middle of the esophagus. The patient later vomited a barium mixture.

The roentgenographic examination confirms the roentgenoscopic findings showing on the

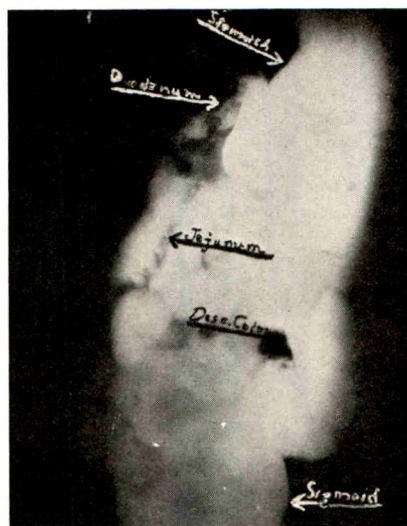


FIG. 1. Showing the barium enema filling the rectum, sigmoid, colon, jejunum, stomach and esophagus.

immediate films large areas of barium throughout the left abdomen filling the small intestine, stomach, descending colon, sigmoid and rectum. A small amount of barium is seen in the first portion of the duodenum, and esophagus (Fig. 1).

*Conclusion:* Gastro-jejuno-colic fistula.



# THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

*Editor:* LAWRENCE REYNOLDS, M.D.

*Editorial Board:* A. C. CHRISTIE, M.D. H. K. PANCOAST, M.D. WILLIAM DUANE, PH.D.

*Advisory Board for Pathology:* JAMES EWING, M.D. EUGENE OPIE, M.D. A. S. WARTHIN, M.D.

*Collaborating Editors:* The Officers and Committee Members of the Societies of which this JOURNAL is the official organ, whose names appear on this page, are considered collaborating editors of this JOURNAL.

*Foreign Collaborators:* A. BÉCLÈRE, M.D., PARIS, GÖSTA FORSSELL, M.D., STOCKHOLM, G. F. HAENISCH, M.D., HAMBURG, R. LEDOUX-LEBARD, M.D., PARIS.

*Publisher:* CHARLES C. THOMAS, SPRINGFIELD, ILL.

*Issued Monthly. Subscription \$10.00 per year, \$11.00 in Canada and \$12.00 in foreign countries. Advertising rates submitted on application. Editorial office, 110 Professional Building, Detroit, Mich. Office of publication, 220 E. Monroe St., Springfield, Ill. Information of interest to all readers will be found on page iv.*

## *Officers and Standing Committees*

### THE AMERICAN ROENTGEN RAY SOCIETY

*President:* H. M. IMBODEN, New York City;  
*President-Elect:* A. B. MOORE, Washington, D. C.;  
*1st Vice-President:* H. E. RUGGLES, San Francisco, Calif.; *2d Vice-President:* B. H. NICHOLS, Cleveland, Ohio; *Secretary:* JOHN T. MURPHY, 421 Michigan St., Toledo, Ohio; *Treasurer:* WILLIAM A. EVANS, 10 Peterboro St., Detroit, Mich.; *Librarian and Historian:* H. W. DACHTLER, Toledo, Ohio.

*Executive Council:* W. F. MANGES, Chairman, 235 S. 15th St., Philadelphia, Pa., L. R. SANTE, St. Louis, Mo., F. M. HODGES, Richmond, Va., H. M. IMBODEN, New York City, A. B. MOORE, Rochester, Minn., LAWRENCE REYNOLDS, Detroit, Mich., JOHN T. MURPHY, Toledo, Ohio, WILLIAM A. EVANS, Detroit, Mich.

*Committee on Laws and Public Policy:* B. R. KIRKLIN, Chairman, Rochester, Minn., FRED M. HODGES, Richmond, Va., WILLIAM E. CHAMBERLAIN, San Francisco, Calif.

*Committee on Safety and Standards:* P. M. HICKEY, Chairman, University Hospital, Ann Arbor, Mich., H. K. PANCOAST, Philadelphia, Pa., W. D. COOLIDGE, Schenectady, N. Y., A. U. DESJARDINS, Rochester, Minn., H. J. ULLMANN, Santa Barbara, Calif., B. H. NICHOLS, Cleveland, Ohio, G. E. RICHARDS, Toronto, Canada, R. R. NEWELL, San Francisco, Calif.

*Publication Committee:* WILLIAM A. EVANS, Chairman, Detroit, Mich., W. F. MANGES, Philadelphia, Pa., L. R. SANTE, St. Louis, Mo.

*Leonard Prize Committee:* P. M. Hickey, Chairman, Ann Arbor, Mich., W. B. BOWMAN, Los Angeles, Calif., A. C. CHRISTIE, Washington, D. C., W. A. EVANS, Detroit, Mich., G. W. GRIER, Pittsburgh, Pa., B. H. NICHOLS, Cleveland, Ohio, G. E. PFAHLER, Philadelphia, Pa.

*Tube Committee:* DAVID R. BOWEN, Chairman, Philadelphia, Pa., I. H. LOCKWOOD, Kansas City, Mo., E. C. ERNST, St. Louis, Mo., G. W. GRIER, Pittsburgh, Pa., E. A. POHLE, Madison, Wis.

*Member, National Research Council:* W. F. MANGES, Philadelphia, Pa.

*Delegate to Third International Congress, Paris,*

*July 27-31, 1931:* P. M. HICKEY, Ann Arbor, Mich.;  
*Alternate,* LEOPOLD JACHES, New York City.

*Editor:* LAWRENCE REYNOLDS, 110 Professional Building, Detroit, Mich.

*Editorial Board:* A. C. CHRISTIE, H. K. PANCOAST, WM. DUANE.

*Advisory Board for Pathology:* JAMES EWING, EUGENE OPIE, ALDRED S. WARTHIN.

*Publisher:* CHARLES C. THOMAS, 220 East Monroe St., Springfield, Ill.

*Thirty-first Annual Meeting:* West Baden Springs Hotel, West Baden, Indiana, Sept. 23-26, 1930.

### THE AMERICAN RADIUM SOCIETY

*President:* H. J. ULLMANN, 1520 Chapala St., Santa Barbara, Calif.; *President-Elect:* SANFORD WITHERS, Denver, Colo.; *First Vice-President:* BURTON J. LEE, New York City; *Second Vice-President:* EDWARD H. SKINNER, Kansas City, Mo.; *Secretary:* G. W. GRIER, Jenkins Arcade, Pittsburgh, Pa.; *Treasurer:* ZOE A. JOHNSTON, Jenkins Arcade, Pittsburgh, Pa.

*Executive Committee:* CURTIS F. BURNAM, Chairman, 1418 Eutaw Place, Baltimore, Md., EDWIN C. ERNST, St. Louis, Mo., H. H. BOWING, Rochester, Minn.

*Program Committee:* SANFORD WITHERS, Chairman, 304 Republic Bldg., Denver, Colo., BURTON J. LEE, New York City, HENRY SCHMITZ, Chicago.

*Publication Committee:* EDWARD H. SKINNER, Chairman, 1532 Professional Bldg., Kansas City, Mo., HENRY SCHMITZ, Chicago, Douglas Quick, New York City.

*Research and Standardization Committee:* G. FAILLA, Chairman, Memorial Hospital, New York City, H. J. ULLMANN, Santa Barbara, Calif., R. B. GREENOUGH, Boston, Mass.

*Education and Publicity Committee:* SANFORD WITHERS, Chairman, 304 Republic Bldg., Denver, Colo., G. E. PFAHLER, Philadelphia, T. D. QUIGLEY, Omaha, Nebr.

*Sixteenth Annual Meeting:* Philadelphia, 1931.

*Committee on Arrangements:* G. E. PFAHLER, Chairman, 1321 Spruce St., Philadelphia, W. S. NEWCOMET, Philadelphia, H. K. PANCOAST, Philadelphia, W. H. SCHMIDT, Philadelphia, W. L. CLARK, Philadelphia.



# EDITORIAL

## THE GOULSTONIAN LECTURES ON CALCIUM AND PHOSPHORUS METABOLISM

THE Goulstonian Lectureship commemorates the name of Theodore Goulston, a Fellow of the Royal College of Physicians who died in the year 1632, leaving a bequest of £200 to the Royal College of Physicians for the maintenance of an annual pathological lecture. "This was to be read sometime between Michaelmas and Easter, by one of the four youngest doctors of the college. A dead body was, if possible, to be procured, and two or more diseases treated of, upon the forenoons and afternoons of three successive days."\* The first Goulstonian Lecture was given in 1639 and for almost three hundred years, except for a few breaks owing to the Civil War, the late war, and other causes, it has been given annually.

The 1930 Goulstonian Lectures were given by Dr. Donald Hunter, who chose for his topic "The Significance to Clinical Medicine of Studies in Calcium and Phosphorus Metabolism,"† and in a critical and careful review he summarizes the present knowledge of this important subject and gives indications of its practical value to clinical medicine.

For a long time it has been known that calcium is an element essential to the life of plants and animals, the green parts of plants being especially rich in calcium, from which source herbivorous animals obtain principally the calcium essential to their maintenance. Man, on the other hand, derives most of his calcium from milk, cheese, butter, eggs, green vegetables and nuts, and calcium exists in our food in both organic and inorganic combina-

tions. "It is probable that digestive changes convert it entirely into the inorganic form so that it is absorbed as calcium salts partly or completely ionized." It is well known that an excess of calcium in the diet is desirable for the reason that the interaction with carbonates of the digestive juices reconverts some of the ingested calcium into insoluble carbonate, which escapes absorption and is lost in the stools. The primary function of calcium in the body is the formation of bone but, as Hunter points out, it has perhaps been insufficiently emphasized that the skeleton of the mammal is not only a supporting structure but is also a reservoir of calcium and phosphorus and that "even after full growth is complete, bone salts are being continuously removed and renewed, and they are not once and for all laid down and fixed." Since bone is a considerable store house of calcium the skeleton can be drawn upon not only when there is a calcium deficiency but apparently also in a normal procedure such as the production of milk.

Not only does calcium play an important part in the formation of the skeleton, but it has an additional rôle by maintaining along with other ions a balance system which determines the irritability of muscle and nerve and in this way calcium ions help to control the heart beat, the contractility of plain and striped muscle and the transference of impulses at the neuromuscular junctions and through synapses.

Since phosphorus plays such an important part in the utilization and storage of calcium a knowledge of the metabolism of phosphorus is also essential to a clear understanding of these functions. Phos-

\* Hutchinson, Benjamin. *Biographica Medica*. Volume I. J. Johnson, London, 1799, p. 367.

† *Lancet*, Apr. 26, 1930, 1, 879-905; May 3, 1930, 1, 947-957; May 10, 1930, 1, 999-1008.

phorus compounds take part in at least four important metabolic processes: they are in some way essential to the utilization and storage of carbohydrates; they play a part in the chemical changes which precede the contraction of muscle; they are concerned with the acid base equilibrium and are essential to the formation of bone. "These manifold requirements and functions depend, also, on the integrity in which an accessory food factor, vitamin D, the internal secretion of the parathyroid glands, and an enzyme called phosphatase, play their part."\* The normal biological process of ossification and the maintenance and repair of bone in the adult is little known. Hunter agrees with Robison, Kay and their collaborators that there is no doubt that phosphatase plays an important part in these two processes, and also that phosphatase may play an important part in some generalized diseases such as osteitis fibrosa cystica, secondary carcinomatosis of bone, and rickets.

Of particular interest to the clinician and the roentgenologist is the discussion of the part played by the parathyroids in calcium metabolism and its effect on the skeleton. MacCallum and Voegtlin were the first to demonstrate a reduction in the calcium content in the serum after parathyroidectomy. It remained for Collip to isolate an active extract of the parathyroid glands and injections of this substance abolished tetany in parathyroidectomized dogs, the serum calcium being restored to normal. It was demonstrated that the administration of Collip's extract to normal dogs raises the serum calcium above normal to such an extent as to make this a means of standardization.

Hunter and Aub, in their studies on lead poisoning, found that injection of parathyroid extract causes a loss of calcium from the bones and were enabled by these studies to clear up certain questions in

calcium excretion which led to their conclusion that certain cases of generalized osteitis fibrosa cystica in which there is a diminished density of the bones and a high calcium content of the serum were due to lesions of the parathyroid glands. A number of cases of generalized osteitis fibrosa cystica have been recorded in which parathyroid tumor was found, in which after a removal of the tumor there was a distinct lessening in the calcium content of the serum and the bones became more dense.

It has been known for some time that in exophthalmic goiter the density of the bones is diminished and that the excretion of the calcium is greatly increased but that in these hyperthyroid cases the level of the calcium in the blood does not rise. Hunter was unable to offer an explanation for this phenomenon. Turnbull, in his histological observations on the long bones, both in cases of exophthalmic goiter and of hyperactivity of the parathyroids, found that the diminished density of the bone is due to lacunar resorption by osteoclasts and is distinctly different from the diminished density seen in rickets and osteomalacia in which less calcium is laid down in the osteoid tissue.

Hunter, after his studies on the relation of the parathyroid glands to generalized osteitis fibrosa cystica, continued his studies on the more common form, focal osteitis fibrosa, a disease which affects one or more bones but is usually not disabling, its progress being slow and having a tendency to become arrested. It is a disease occurring principally in adolescents and may be symptomless until spontaneous fractures occur. In all the cases of focal osteitis fibrosa cystica which he investigated he found the serum calcium and the plasma phosphate and phosphatases to be normal. These findings are of considerable importance in these cases in that apparently the parathyroids are not directly concerned in the focal type of osteitis fibrosa and that in this type

\* Editorial, Calcium and phosphorus, *Lancet*, May 10, 1930, 1, 1022-1023.

"exploration of the neck is unjustifiable."

Most observers are agreed that in rickets and osteomalacia the essential abnormality is the same, that is, a deficient calcification of the osteoid tissue; that osteomalacia is really a manifestation of rickets in adult life; that both diseases are distinctly concerned with the storage of vitamin D, and that in the majority of cases there is an actual calcium deprivation. Also in both diseases the phosphorus content of the plasma is low and in both the abnormalities in the blood are promptly restored to normal by the use of cod-liver oil, ultraviolet light or irradiated ergosterol and quite promptly ossification begins to proceed normally.

Hunter discusses other diseases of bone and indicates that estimations of the phosphatase content of the plasma may lead to important advances in our knowledge of some skeletal diseases which are obscure at the present time. For example, osteitis deformans has been observed for a long time but little was known of its etiology until Kay showed that phosphatase is always in excess in the plasma in this disease.

Hunter and Aub in their studies on lead poisoning have shown that lead, mercury, arsenic, silver and radium follow calcium very closely in their behavior both as to storage in the bones and their elimination, and this knowledge they applied in the treatment of lead poisoning; Flinn and Seidlin in their treatment of radium cases with parathormone extract report a phenomenal increase in the rate of elimination of the radium, showing a close connection between radium and calcium storage and elimination unless, as they suggest, one makes a bold assumption that parathormone exercises a specific therapeutic action on radium fixed in the bony skeleton, but since Hunter and Aub have made almost identical observations as regards the excretion of lead after the injection of parathormone it must be admitted that the good results obtained in its

injection in these cases are due entirely to its influence on calcium metabolism.

Hunter, in his discussion of calcium and phosphorus metabolism, calls attention to the rather interesting observation that Styfsiekte or "stiff sickness" of cattle is a disease which has to do with phosphorus deficiency. This "stiff sickness" is very prevalent in South African cattle; the disease occurs in Minnesota and is probably identical with the "Grand Traverse disease" of Michigan, "impaction paralysis" and the "cripples" of Australia and "Midland disease" of Tasmania. The work of Sir Arnold Theiler has shown this to be a disease comparable to osteomalacia of the low phosphorus type and is curable by the addition of phosphates to the diet. The animals most affected are heifers with the first calf, cows in lactation, and growing cattle. The animals "develop an intense craving for bones, a symptom which is termed osteophagia. This compels them to travel long distances to find carcasses to eat, and they may even kill and eat young lambs. On the Veld they may sometimes be seen and heard in the distance crunching bones. The disease shows itself in retardation of growth and abnormal skeletal development, the most obvious features of which are the thickening of the epiphyses of the leg bones, most pronounced at the metacarpus and first phalangeal joints. The gait is stiff and lame. . . . "Styfsiekte is therefore rickets or osteomalacia of the 'low phosphorus' type produced by a mass experiment of Nature in areas where the soil and grass are deficient in phosphorus." Sunlight is unable to prevent its occurrence and the routine preventive is bone meal. Milk fever of cows is associated with a low calcium content of the serum and can be successfully treated by calcium injections.

Hunter comments on the disappointing results of calcium administration as a therapeutic agent and points out the fact that there is a constant supply of calcium in the food and a large supply available

in bones but that the regulating mechanism is at fault and when this mechanism breaks down the tissues suffer from calcium deficiency, this being the reason why cod-liver oil, ultraviolet light, irradiated ergosterol, parathyroid or thyroid extract is often of greater value than the direct administration of calcium salts.

The studies of calcium and phosphorus metabolism are so involved that only those who are directly interested can hope to gain any extensive knowledge of

them except where they touch more acutely their clinical application. To roentgenologists who are constantly having to deal with and interpret bone densities it is of extreme importance that the various etiological factors in the production of bone densities be kept in mind in order that a proper interpretation may be made. Such studies as Dr. Hunter and his collaborators have been engaged in point the way to the further elucidation of other still obscure bone manifestations.





## SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

---

*Items for this section solicited promptly after the events to which they refer.*

---

### MEETINGS OF ROENTGEN SOCIETIES\*

UNITED STATES OF AMERICA  
**AMERICAN ROENTGEN RAY SOCIETY**  
Secretary, Dr. John T. Murphy, 421 Michigan St., Toledo, Ohio.  
Thirty-first annual meeting: West Baden Springs Hotel, West Baden, Indiana, Sept. 23-26, 1930.  
**AMERICAN COLLEGE OF RADIOLOGY**  
Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles, Calif.  
Annual Meeting: Philadelphia, 1931.  
**SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION**  
Secretary, Dr. G. W. Grier, Jenkins Arcade, Pittsburgh, Pa.  
Annual meeting: Philadelphia, 1931.  
**RADIOLOGICAL SOCIETY OF NORTH AMERICA**  
Secretary, Dr. I. S. Trostler, 812 Marshall Field Annex, Chicago, Ill.  
Sixteenth annual session: Los Angeles, Calif., Dec. 1-5, 1930.  
**RADIOLOGICAL SECTION, LOS ANGELES COUNTY MEDICAL SOCIETY**  
Secretary, Dr. Orville N. Meland, 1407 S. Hope St., Los Angeles.  
Meets on the third Wednesday of each month at the California Hospital.  
**RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION**  
Secretary, Dr. W. S. Lawrence, Medical Arts Bldg., Memphis, Tenn.  
**BUFFALO RADIOLOGICAL SOCIETY**  
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St.  
Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.  
**CHICAGO ROENTGEN SOCIETY**  
Secretary, Dr. Robert A. Arens, Michael Reese Hospital.  
Meets monthly on second Thursday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.  
**CLEVELAND RADIOLOGICAL SOCIETY**  
Secretary, Dr. Harry L. Farmer, 2930 Prospect Ave.

Meetings are held at 6 o'clock at the University Club on the fourth Monday evening of each month from September to April, inclusive.

#### **DETROIT ROENTGEN RAY AND RADIUM SOCIETY**

Secretary, Dr. O. J. Shore, Fisher Building,  
Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

#### **CENTRAL ILLINOIS RADIOLOGICAL SOCIETY**

Secretary, Dr. H. C. Kariher, Decatur, Illinois  
Regular meetings held quarterly.

#### **INDIANA ROENTGEN SOCIETY**

Secretary, Dr. J. N. Collins, Indianapolis, Ind.  
Annual meeting each February 22 in Indianapolis.

#### **MILWAUKEE ROENTGEN RAY SOCIETY**

Secretary, Dr. J. E. Habbe, 221 Wisconsin Ave., Milwaukee.

Meets first Friday in October, December, February and April.

Place of meeting designated by the president.

#### **MINNESOTA RADIOLOGICAL SOCIETY**

Secretary, Dr. L. G. Rigler, University Hospital, Minneapolis, Minn.

#### **NEW ENGLAND ROENTGEN RAY SOCIETY**

Secretary, Dr. Thomas R. Healy, 370 Marlboro St., Boston, Mass.  
Meets monthly on third Friday, Boston Medical Library.

#### **NEW YORK ROENTGEN SOCIETY**

Secretary, Dr. Robert E. Pound, Fifth Avenue Hospital.  
Meets monthly on third Monday, New York Academy of Medicine.

#### **CENTRAL NEW YORK ROENTGEN RAY SOCIETY**

Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

#### **PACIFIC COAST ROENTGEN RAY SOCIETY**

Secretary, Dr. Harold B. Thompson, Seattle, Wash.  
Two meetings a year.

#### **PENNSYLVANIA RADIOLOGICAL SOCIETY**

Secretary, Dr. W. E. Reiley, Clearfield, Penna.  
Two meetings a year, April and October.

\* Secretaries of societies not here listed are requested to send the necessary information to the Editor.

**PHILADELPHIA ROENTGEN RAY SOCIETY**  
Secretary Dr. John T. Farrell, Jr., 235 S. 15th St., Philadelphia.

Meets monthly on first Thursday evening, Pennsylvania Hospital.

**ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.**

Secretary, Dr. James M. Flynn, 282 Alexander St.  
Meets monthly on the first Friday evening at 7:45 at the Rochester Medical Association Building.

**ST. LOUIS ROENTGEN CLUB**

Secretary-Treasurer, Dr. L. R. Sante, Missouri Building

Meets first week of each month. Time and place of meetings designated by president.

**TEXAS RADIOLOGICAL SOCIETY**

Secretary-Treasurer, Dr. C. P. Harris, Houston, Texas.

Meets annually one day preceding the meeting of the Texas State Medical Association.

**UNIVERSITY OF MICHIGAN ROENTGEN RAY SOCIETY**

Secretary, Dr. D. M. Clark, University Hospital, Ann Arbor, Mich.

Meets every Wednesday evening from September to July, at 7:30 o'clock in the amphitheatre of the University Hospital.

**VIRGINIA ROENTGEN RAY CLUB**

Secretary, Dr. Wright Clarkson, 205 S. Sycamore St., Petersburg, Va.

Next meeting, Norfolk, Va., 1 P.M., Wednesday, Oct. 22, 1930.

#### CUBA

**SOCIEDAD CUBANA DE RADIOLOGIA Y FISIOTERAPIA**

Secretary, Dr. Francisco Padron, Enrique Villuendas 64, Havana, Cuba. Meets monthly in Havana.

#### BRITISH EMPIRE

**BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY**

Meets on the third Thursday of each month, from November to June inclusive, at 8:15 P.M., at 32 Welbeck St., London, W. 1., or as advertised.

**ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)**

Meets on the third Friday of each month during the winter at 8:30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

**SECTION OF RADIOLOGY AND MEDICAL ELECTRICITY, AUSTRALASIAN MEDICAL CONGRESS**

Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

**RADIOLOGICAL SECTION OF THE, VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION**

Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.

Meets monthly at Melbourne during the winter.

**SECTION ON RADIOLOGY, CANADIAN MEDICAL ASSOCIATION**

Secretary, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.

**RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION**

Secretary, Dr. P. C. Fenwick, The Hospital, Christ-church.

Meets annually.

#### CONTINENTAL EUROPE

**BELGIAN SOCIETY OF ROENTGENOLOGY**

Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).

Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

**SOCIÉTÉ DE RADIOLOGIE MÉDICALE DE FRANCE**

Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

**SOCIÉTÉ SUISSE DE RADIOLOGIE (SCHWEIZERISCHE RÖNTGEN-GESELLSCHAFT)**

Secretary for French language, Dr. A. Grosjean, La Chaux de Fonds.

Secretary for German language, Dr. Scheurer, Molzgasse, Biel.

Meets annually in different cities.

**SOCIÉTÉ FRANÇAISE D'ELECTROTHÉRAPIE ET DE RADIOLOGIE MÉDICALE**

Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

**ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHOSLOVAKIA**

Secretary, Dr. Walter Altschul, German University, Prague, 11/52.

**DEUTSCHE RÖNTGEN-GESELLSCHAFT (GESELLSCHAFT FÜR RÖNTGENKUNDE UND STRAHLENFORSCHUNG)**

Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.

Permanent secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.

**SUD- UND WESTDEUTSCHE RÖNTGENGESELLSCHAFT**

Meets annually in different cities.

**NORD- UND OSTDEUTSCHE RÖNTGENGESELLSCHAFT**

Meets annually in different cities.

**DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY**

Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

# **SOCIETA ITALIANA RADIOLOGIA MEDICA**

Secretary, Professor M. Ponzio, University of Turin, Turin.

# **SOCIETATEA ROMANA DE RADIOLOGIE SI ELECTROLOGIE**

Secretary, Dr. Nicolae Busila, 44 Elizabeta Blvd., Bucarest.

Meets second Monday in every month with the exception of July and August.

# **ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR** in the State Institute of Roentgenology and Radiology, 6 Roentgen St.

Secretaries, Drs. S. A. Reinberg and S. G. Simonson.

Meets annually.

# **LENINGRAD ROENTGEN RAY SOCIETY**

Secretaries, Drs. S. G. Simonson and G. A. Gusterin.

Meets monthly on the first Monday at 8 o'clock in the State Institute of Roentgenology and Radiology, Leningrad.

# **MOSCOW ROENTGEN RAY SOCIETY**

Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.

Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

# **POLISH SOCIETY OF RADIOLOGY**

Secretary, Dr. A. Elektorowicz, 19 Hoza St., Warsaw. Meets annually.

# **WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY**

Secretary, Dr. B. Krynski, 11 Zielna St.

Meets once a month except in the summertime.

# **SCANDINAVIAN ROENTGEN SOCIETIES**

The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with the exception of the Denmark Society, meets every second month except in the summertime:

# **SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN**

Meets in Stockholm.

# **SOCIETY OF MEDICAL RADIOLOGY IN NORWAY**

Meets in Oslo.

# **SOCIETY OF MEDICAL RADIOLOGY IN DENMARK**

Secretary, Dr. O. Wissing, Copenhagen.

Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

# **SOCIETY OF MEDICAL RADIOLOGY IN FINLAND**

Meets in Helsingfors.

# **VIENNA SOCIETY OF ROENTGENOLOGY**

Secretary, Professor Holzknrecht, Vienna, IX, General Hospital.

Meets on the first Tuesday of each month from October to July.

# **VIENNA LETTER**

(From Our Special Correspondent)

# **NEW POSSIBILITIES IN ROENTGEN DIAGNOSIS**

Dr. A. Bouwers, Professor of Roentgenology in Eindhoven, Holland, as a guest of the Royal Medical Society of Budapest, discussed the latest achievements in roentgen diagnosis. He emphasized that advancements may be found in the following domains: (1) the quality of the roentgenograms; (2) the lessening of the dangers connected with diagnostic procedures, and (3) the simplification of the apparatus. The improvement in the contrast of the roentgenograms has been brought about by reason of our ability to regulate the quality of the rays; the sharpness of the roentgenograms goes hand in hand with the shortening of the time of exposure. This aim could only be obtained by improvement of the photographic material such as the sensitivity of the films, on the one hand, and on the other, the improvement is in direct proportion to the improvement of the tube in its ability to carry heavier loads. In this respect a great progress has been inaugurated by the roentgen tube with revolving anode, constructed and invented by Professor Bouwers. In this tube the anode is revolved by a special electrical appliance and its purpose is to distribute the heat evenly through the whole cone-like surface of the revolving anode. By this construction we are able to increase the power of the tube at least seven-fold. That means that the time of exposure is lessened considerably and thereby the roentgenogram gains immensely in its sharpness.

In the dangers incident to the use of the tubes we are fairly perfectly protected by the various protective appliances. In Europe the most popular are the Metalix tubes in which, as its name implies, protection is rendered by the metal housing of the tube with a window through which

the rays pass in only one direction. Perfect protection against high tension currents has been achieved in the manufacture of some deep therapy apparatus, while the majority of the installations leave much to be desired from this point of view. In the portable diagnostic sets, safety is assured from high tension currents by special grounding of these currents. Most sets are still too complicated. Up to this time manufacturers have been endeavoring to add mechanical features to their apparatus, while now the constructors' principal aim is reduction in size and a simplification of the apparatus.

#### RADIATION TREATMENT OF CANCER

Dr. Gösta Forssell, Professor of Roentgenology at the University of Stockholm, and Editor of the well-known journal, *Acta radiologica*, was a guest of the Vienna Austrian Society for Research in the Control of Cancer. He gave an account of his twenty years' experience in the Radium Institute at Stockholm in the radiation treatment of cancer. In this Institute he has been able to prove that radium therapy gives at least the same results as does the surgical treatment in the majority of cancerous growths. His experience has indicated that radium therapy combined with surgical intervention leads to much better results than does one procedure alone. Also that radiotherapy applied prior to the operative interference reduces the size of the tumor and renders the tissues less resistant, while irradiation following operation destroys the remainder of the cancer cells left at the site of operation. Of course the best results are obtained in well-equipped institutes and where the main stress is laid on radiotherapy and not on surgical interference. A radiotherapeutic institute should possess at least 2 grams of radium. It is folly to distribute the radium among several hospitals, the results if added together being inferior to those

obtained if the whole is used in one hospital.

#### INDIRECT ROENTGEN BURNS

In a recent address given by Professor Groedel and Dr. Lossen, Frankfurt a. M., a very exhaustive discussion of the subject of roentgen burns was given. Professor Groedel emphasized the fact that besides technical errors and oversights, the cumulative effects of roentgen rays is not to be underestimated in the pathogenesis and etiology of roentgen burns. To the cumulative effects are often added the harmful effects of medicaments such as adrenalin, arsenic, quinine, iodine, salvarsan, and similar ointments, compresses and plasters, and to these may be added the irritating effects on the skin following roentgen treatment caused by fomentations, hyperemic congestion and the application of ultraviolet, Finsen and sun rays.

#### THE RAISING OF THE TARIFF ON IMPORTED ROENTGEN APPARATUS IN HUNGARY

According to the Hungarian Ministry of Finance, roentgen apparatus and their accessories will become subject to a huge increase in their import duties, this amounting to 800 per cent in comparison with the present duty. The enactment which is to protect the interests of the Hungarian manufacturers has caused great indignation in medical circles because the new order is apt to handicap the modernization of doctors' offices. To overcome this difficulty a Holland firm, Messrs. Phillips, have offered their apparatus at the prevailing prices, they themselves assuming the increased duty. This gesture was gratefully received by the Hungarian medical profession, particularly at this time when the medical profession is suffering from the general economic and financial depression.



### THIRD INTERNATIONAL CONGRESS OF RADIOLOGY

PARIS, JULY 27-31, 1931

The five United States Delegates to the Third International Congress of Radiology met in Detroit on June 23, 1930, to discuss ways and means of apportioning the necessarily limited number of contributions to the scientific program from the United States.

It was decided that all those wishing a place on the program should communicate with the Secretary of the American Committee, Dr. Edwin C. Ernst, Beaumont Medical Building, St. Louis, Mo., not later than October 1, 1930.

The scientific program of this Congress will be divided into six sections as follows:

- (1) Roentgen diagnosis
- (2) Roentgen and curie therapy
- (3) Radiobiology
- (4) Radiophysics
- (5) Natural and artificial heliotherapy
- (6) Medical electrology.

All requests for space on the program must include the full title of the paper, name or names of the authors, together with a brief abstract not to exceed 400 words.

The local committee of five will review the requests and make the necessary recommendations to the International Committee, but in addition, whenever it may be deemed expedient, the opinion of other radiologists and specialists will be invited so that an impartial decision may be reached.

President Antoine Bécélère has informed the American Committee that each contribution will be limited to fifteen minutes. Furthermore, should the communications submitted by the respective countries be too numerous, the International Committee in Paris reserves the right to limit their number even though the local committee had accepted such contributions.

The meetings of the Congress will be

held at the Sorbonne, which is located within the city limits and is the site of the University of Paris. There will be no special hotels provided for headquarters, and all participants in the Congress are at liberty to select such hotels as may suit their individual needs. It is urged that those anticipating attending the Congress make reservations as early as possible in order to secure good accommodations.

EDWIN C. ERNST, *Secretary*  
United States Delegation

### THIRD INTERNATIONAL CONGRESS OF RADIOLOGY

#### GENERAL ANNOUNCEMENT

A written announcement of communications intended for the Congress must be sent in before January 1, 1931. A type-written abstract (in English, French or German) not exceeding 400 words of each paper should reach the offices of the Congress before April 1, 1931. These abstracts will be assembled in a printed volume which will be distributed to members before the opening of the Congress. Each member is entitled to one paper only, the reading of which shall not exceed fifteen minutes.

Should the papers submitted be too numerous for all to be read, the Bureau of the Congress shall have the right to limit the number or shorten the time of presentation.

Members of the various societies of radiology wishing to attend the Congress are requested to fill in and return as soon as possible the accompanying form (see advertising page vii) together with a sum of 300 French francs as membership fee. Those members of the Congress who will be accompanied by members of their family desirous of having a part in the receptions and festivities during the Congress, should state on the form the number of persons and should send a fee of 50 French francs for each individual.

Each member of the radiological societies shall receive this general information together with the subscription form and further information will be forwarded later to all those sending in their subscription to the Congress.

An exhibition will be arranged in connection with the Congress. Persons or firms wishing to take part in the exhibition will obtain all particulars from M. H. Pilon, Commissary General of the exhibition, 34 Boulevard de Vaugirard, Paris, XV<sup>e</sup>.

Please address all communications and correspondence to the Offices of the Third International Congress of Radiology, 122 Rue La Boetie, Paris, VIII<sup>e</sup>.

ANTOINE BÉCLÈRE, *President*

R. LEDOUX-LEBARD, *Secretary General*

#### TREATMENT OF ANGINA PECTORIS

*To the Editor:*

In my article on "The Treatment of Angina Pectoris by Paravertebral Short Wave Radiation" which appeared in the August, 1930, issue of the American Journal of Roentgenology and Radium Therapy (p. 163), I stated that I could find but two references in the American literature concerning similar treatment. I have since noted in an article (Delherm,

L., and Beau, H. La radiothérapie du sympathique dans certaines affections cardio-vasculaires. *J. de radiol. et d'électrol.*, July, 1930, 14, 391) a reference to an article on this subject by Beall and Jagoda (Roentgenological treatment of neurocirculatory diseases. *South. M. J.*, 1926, 19, 590-591).

I wish to give credit for this earlier work which I accidentally failed to note and request that you make this acknowledgment in the pages of the Journal.

MARCY L. SUSSMAN

#### WESTINGHOUSE FORMS X-RAY COMPANY

The Westinghouse Electric and Manufacturing Company has recently announced its entrance into the x-ray field through a newly organized company known as the Westinghouse X-Ray Company, Incorporated. Two x-ray companies already well-known to roentgenologists, the Wappler Electric Company of Long Island City, New York, and the American X-Ray Corporation of Chicago, will be identified with this organization.

The officers of the Westinghouse X-Ray Company, Inc., are: A. E. Allen, President; Calvert Townley, Vice-President; Warren H. Jones, Secretary, and T. J. Illing, Treasurer.



## DEPARTMENT OF TECHNIQUE

Department Editor: DAVID R. BOWEN, M.D., Pennsylvania Hospital, Philadelphia, Pa.

### CHOLECYSTOGRAPHY IN THE LEFT LATERO-ANTERIOR POSITION

By I. W. HELD, M.D., *Attending Physician*, and A. ALLEN GOLDBLOOM, M.D., *Adjunct Physician*  
Beth Israel Hospital  
NEW YORK CITY

**V**ISUALIZATION of the gall-bladder by means of the Graham method has revolutionized the diagnosis of gall-bladder disease. The most accepted and certainly very valuable positions in which gall-bladder films are taken are the posteroanterior position with the patient lying on the abdomen, and the erect position, in order to demonstrate the mobility of the gall-bladder.

Recently Chiray, Lomon and Albot\* reported the results of their experimental and clinical work regarding a new position which they have called the left lateroanterior position. They found that when the patient lies on his back the gall-bladder

\* Chiray, M. Lomon, A., and Albot, G. La vesicule biliaire, sa topographie radiologique et clinique, son exploration par le palper abdominal. *Presse méd.*, 1929, 37, 1437-1440.

moves up considerably, is under the liver and remains on a line with the lower border of the liver. When the patient is on the abdomen, as is well known, the gall-bladder is generally vertical. If, however, the patient lies in the left lateroanterior position the liver as a whole moves somewhat to the left leaving a clear space between the kidney and the liver shadows so that the gall-bladder shadow appears most distinctly on the film. The gall-bladder is not covered in any of its parts by the liver. Its density is more marked, and in many cases one is enabled to see even the outline of the cystic duct, where otherwise it would not be seen. Because the gall-bladder in the position they advocate comes much nearer the anterior wall these French

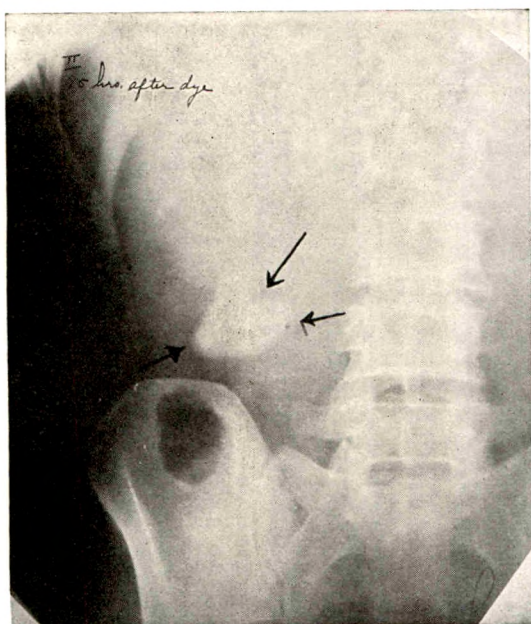


FIG. 1a. Film taken in posteroanterior position. Shows gall-bladder filled, appearing as if held by adhesions, and angulated.

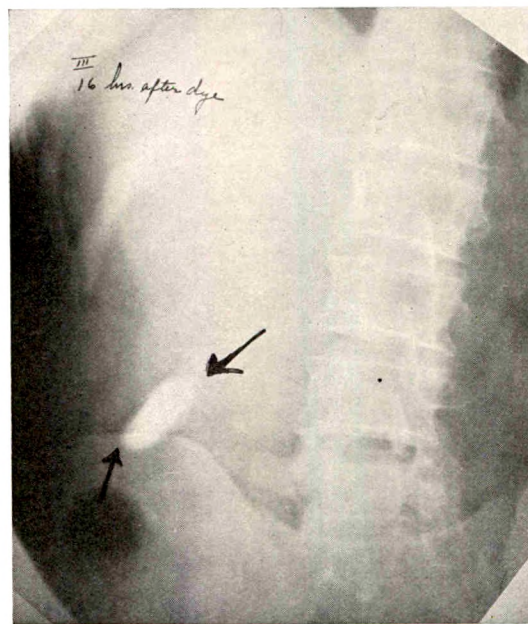


FIG. 1b. Film of same patient taken in left lateroanterior position, showing movability of gall-bladder and no deformity.



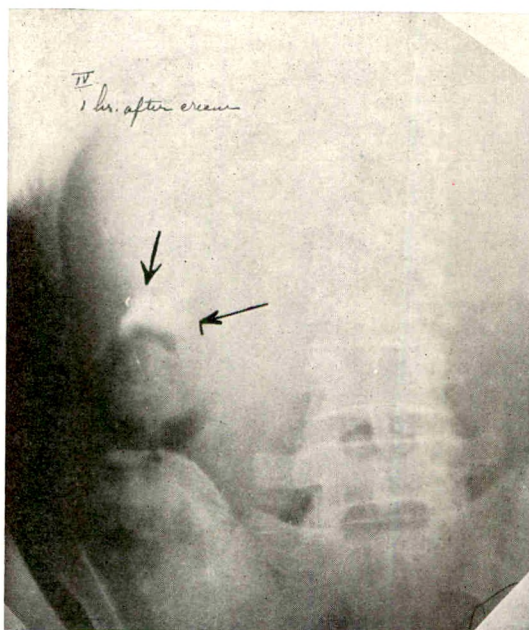


FIG. 1c. Shows gall-bladder empty, moved up and deformed by gas in the colon.

authors have even recommended palpation in this position.

Seeing the advantage of this position, we have now routinely adopted it in addition

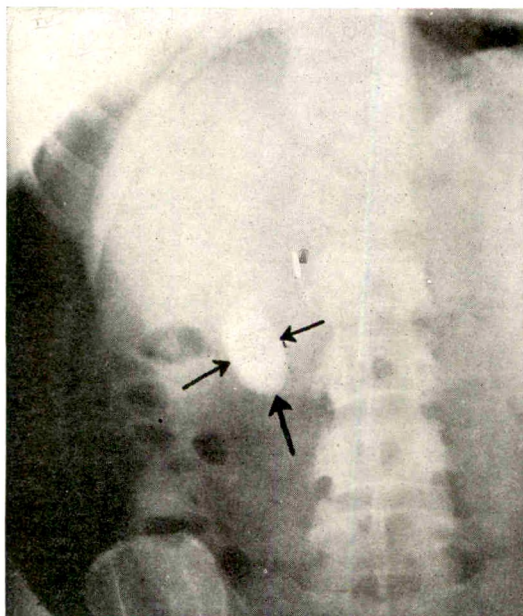


FIG. 2a. Posteroanterior roentgenogram, showing gall-bladder well filled.

to the established positions. We are finding it so advantageous, adding so much to our diagnostic information, that we think it worthy of report. We believe its clinical application should be encouraged, not so much as a matter of choice but as a method of necessity.

The method as we employ it is as follows:

The patient lies on the left side, the shoulders and hips in a straight line. The patient is then rotated to an angle of approximately  $30^{\circ}$ . Using the Potter-Bucky diaphragm and a cone, the average exposure is 3 sec., 5 in. spark gap and 25 ma., focused over the spine from the 12th dorsal to the 2d or 3d lumbar region. The focus should be somewhat lower in thin individuals and

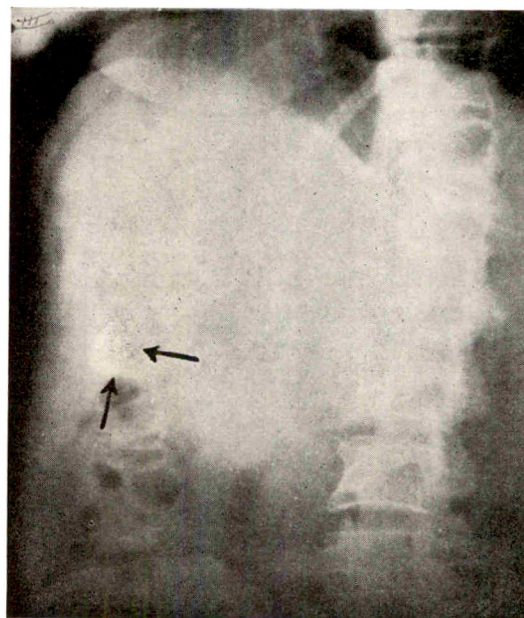


FIG. 2b. Patient in left lateroanterior position, slightly oblique. Film shows gall-bladder beneath the liver and movable.

somewhat higher in those who are stout. However, one always focuses over the spine.

The advantages of the left lateroanterior position are best exemplified in the accompanying films. Figure 1a shows the gall-bladder of an asthenic individual, anteroposterior position. The gall-bladder is angulated, suggesting adhesions. The



## AUTOMATIC POLARIZER FOR SYNCHRONOUS RECTIFIER

By ROBERT B. TAFT, B.S., M.D.  
CHARLESTON, SOUTH CAROLINA

SINCE the introduction of the synchronous rectifier type of machine I have been dissatisfied with the method of determining the polarity by means of the polarity meter and corresponding reversing switches. Difficulty was particularly noticed in setting up a roentgenoscopic machine in the dark and roentgenographic work under difficult circumstances such as for examination of children or uncontrollable adults. In many instances the current was turned backwards into the tube with the resulting dangers.

About eleven years ago I designed and built a simple instrument which automatically polarizes the machine without the attention of the operator as soon as the current is turned on. At that time I was not a physician and applied for a patent on this instrument. The patent, however, was never granted me as it was stated that there was a conflict between my instrument and a British patent of 1892. Undoubtedly this conflict could have been eliminated had I employed skillful lawyers to handle the matter. However, the matter was never followed up and I made no further attempt either to secure a patent or to publish the details until approximately a year ago. Now, believing that this instrument is worthy of consideration by roentgenologists, I have obtained a place on the program of the American Roentgen Ray Society, at the September, 1930, meeting for a paper and a scientific exhibit.

After this place on the program was given me, I found out that a company which manufactures roentgen apparatus has placed on the market an instrument somewhat similar to mine. As I wish to claim priority for this device, I wish to enter as proof a statement from the Commissioner of Patents of the United States

Patent Office dated Nov. 3, 1919, acknowledging receipt for "Patent Application for Automatic Polarizer for Synchronous Rectifier." It is not my intention to have any interest in the sale of this instrument.

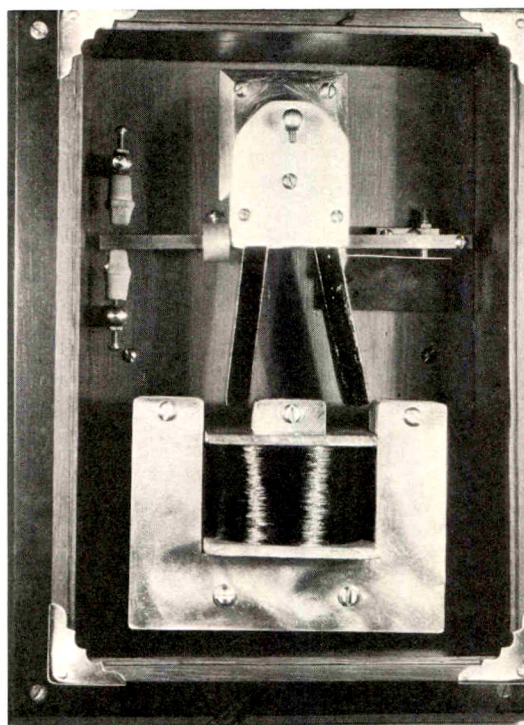


FIG. 1. Photograph of the "automatic polarizer."

As Figures 1 and 2 show, the instrument consists essentially of a permanent horse-shoe magnet actuated by an electromagnet which receives its current from the conventional type of rectifying commutator which is found on all of the synchronous rectifier type of machines. The permanent magnet is mounted in such a way that it is allowed to swing freely carrying with it a contact point which is separated from another contact point when the magnet is swung in a given direction. This pair of contacts is connected in series with a syn-



chronous motor. If the rectifier steps in so that the polarity is correct, the contact remains closed, allowing the motor to run undisturbed. If, however, it steps in with

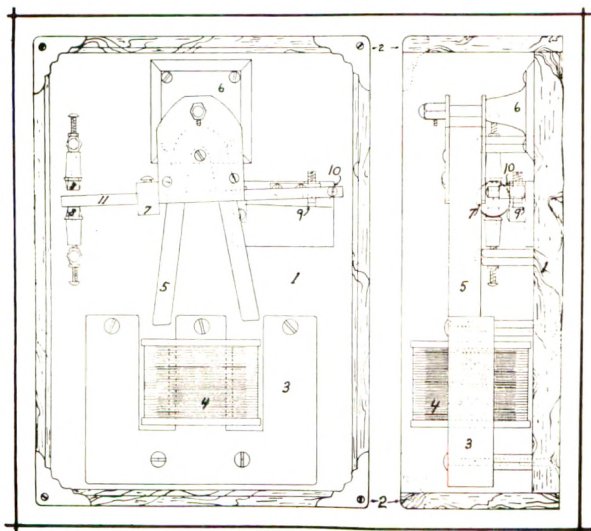


FIG. 2. Drawing of the instrument. 1. Baseboard. 2. Housing cover. 3. Core of electromagnet. 4. Electromagnet. 5. Permanent magnet. 6. Mounting for magnet. 7. Counterweight. 8. Rubber bumpers. 9. Lower contact point. 10. Insulating stud. 11. Square brass rod.

the wrong polarity the electromagnet attracts on one side of the permanent magnet and repels on the other, allowing the motor to slow down until the polarity becomes correct, at which time the magnet swings to a normal position, again closing the contacts and allowing the motor to run on a correct polarity. The above features are shown in the diagram (Fig. 3).

It is to be noted that when the contact points open they disconnect the motor from the mainline but do not cut off the current flowing to the electromagnet through the polarity commutator. This point is of great importance and if it is neglected the apparatus will not function.

The permanent magnet is of the type which was formerly used in the old style Ford magneto, and is suspended vertically from a shaft mounted on the baseboard. To this magnet is bolted a brass rod having

on one end a counterweight and on the other end a bakelite stud. The counterweight holds the magnet hanging off center, and just below the bakelite stud is a bronze spring carrying a contact point so arranged that when the magnet swings in the opposite direction from its normal position this contact point is separated from the one above it. The electromagnet is wound on a laminated core made of soft iron sheets  $1/64$  inch in thickness and bolted together to make a total thickness of  $3/4$  inch. As is shown in the photograph the core is in the shape of the letter "E" and the winding is placed on the middle leg. The winding consists of a half pound of No. 32 B & S enameled wire. In series with this coil is a variable resistance of about 2500 ohms such as can be purchased from any of the larger radio supply houses. The resistance of this rheostat and the electromagnet together is so great that only about 25 ma. of current is allowed to pass. Even after several hours of continuous running the coil does not warm up appreciably.

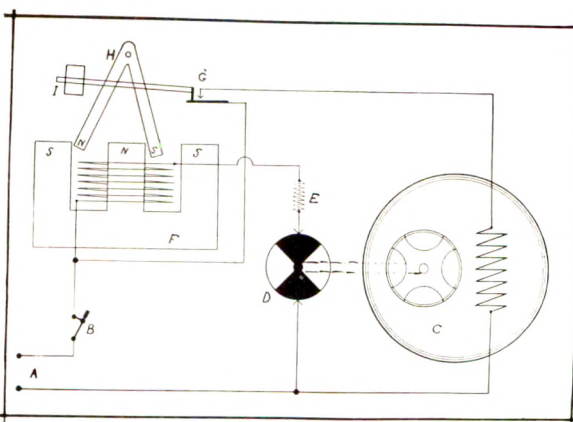


FIG. 3. A. Main line. B. Motor switch. C. Synchronous motor. D. Polarity commutator. E. Resistance unit. F. Core of electromagnet. G. Contact points. H. Permanent magnet. I. Counterweight. S. South poles of magnets. N. North poles of magnets. In this figure, the motor has just stepped off on the wrong polarity. The contacts have opened allowing the motor to slow down. As soon as the polarity becomes correct the magnet will swing to the right, closing the contacts.

The contact points are of a fairly good grade of high-melting point material about  $3/16$  inch in diameter and can be purchased from any automobile supply house that handles ignition parts. These contact points, if properly aligned, will continuously carry the power to the motor on any diagnostic machine without burning.

The permanent magnet and its mounting are purposely made quite heavy to prevent chattering from the alternating current. In order to prevent the permanent magnet from hitting the laminated core where it might become "frozen", a pair of rubber bumpers are so arranged that the magnet is always kept about  $1/16$  inch from the core.

All of the parts of the instrument are bolted onto a baseboard of well-seasoned oak about  $3/4$  inch thick,  $10\frac{1}{4}$  inches long and  $7\frac{1}{4}$  inches wide. A cover of some kind is arranged to keep out dirt. On the instrument of mine the cover is built of oak  $3/8$  inch thick with a glass panel on the front which allows a view of the operation of the instrument. All of the wiring is connected through the back of the board and two pieces of silk-covered lamp cord are brought out through any convenient opening; the pair going to the contact points should be of one color and those going to the coil should be of another. The instrument must be mounted, absolutely level on a rigid wall.

The resistance unit, which was previously mentioned, is not placed in the instrument housing but is best placed within the control cabinet of the roentgen machine where the ends of the wires are connected.

After the instrument is assembled and the contact points adjusted so that they open just before the magnet reaches the extreme end of its swing, the instrument is ready for mounting on any roentgen machine, the only adjustment necessary being the setting of the rheostat. The rheostat is adjusted so that the very minimum amount of current is delivered to the coil that will cause a swing of the magnet when the current becomes of wrong polarity. After continuous use the magnet will not lose its magnetism, as the flow of magnetism from the electromagnet is such that it will be built up instead of being reduced.

In this description no exact dimensions are given since variations will probably be made by each individual who constructs one to suit the convenience of the materials which he has on hand.

#### SUMMARY

An instrument is herein described which automatically polarizes the synchronous rectifier type of machine without the attention of the operator.



## BOOK REVIEWS

*Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.*

LES RAYONS ULTRA-VIOLETS ET INFRA-ROUGES. By W. Vignal, Électro-radiologiste des Hôpitaux de Paris. Paper. Price, 30 Fr. Pp. 239, with 28 illustrations. Paris: Gaston Doin et Cie., 1930.

This little book on ultraviolet and infra-red rays is of precisely the same nature as that on "Électrotherapy" by the same author and which was reviewed in this Journal last year (Volume 21, p. 291). It also is quite suitable for the practitioner; the conservative attitude and pleasing style combined with a most convenient arrangement of the subject matter recommend it to the radiologist interested in light therapy.

The introduction offers a brief historical sketch of the various theories of the nature of light, including the modern quanta theory. This is followed by a detailed discussion of the biophysics of the ultraviolet and infra-red parts of the spectrum with particular consideration of the skin erythema. The present status of the problem of irradiated substances is also sketched. Chapters on the apparatus, dosage of ultraviolet rays and on the general treatment technique precede the therapeutic section where the diseases amenable to light therapy are recorded. Whenever roentgen therapy is indicated in addition to light the dose can be easily identified since potential, tube current, filter, focal skin distance and the dose in French R are given.

A most practical supplement and last chapter relates the "Incidents and Accidents in Light Therapy"; they are subdivided into those due to the apparatus itself and to the therapeutic procedure. In the first group a break of the quartz burner, the dropping of a carbon or ozone poisoning may be considered, while in the second group, injuries to the eyes or systemic reactions, for instance, produced by excessive exposure are mentioned. There is no evidence to date to indicate that late reactions as observed in roentgen therapy appear after exposure to ultraviolet or infra-red rays. A brief bibliography concludes the book.

ERNST A. POHLE

LA SENSITOMÉTRIE CUTANÉE. Introduction à l'actinothérapie rationnelle. By J. Saidman, Directeur-Fondateur de l'Institut d'Actinologie. Paper. Price, 60 francs. Pp. 294, with 82 illustrations in the text and four colored plates. Paris: Gaston Doin et Cie. 1930.

The author presents in this monograph, a preliminary report of his investigations dealing with the reaction of the skin to light. He has developed a sensitometer consisting of a metal plate with eighteen holes of different shapes (oval, triangle, rectangle, rhomboid, pentagon) which are concentrically arranged in two circles. In the center, a watch movement provides for the correct exposure of each area for from one to eighteen minutes, by rotating a disk below the openings. Numbers indicate the respective exposure times. The appearance, degree, and course of the reaction can then be studied. A photochemical method based on the color change in paper sensitized by a paraphenyldiamine nitrate solution and compared with a standard serves as a measuring agent for the various sources of light. The skin reactions obtained under various conditions as related to age, complexion, and disease are tabulated and analyzed. Based on the conclusions drawn from these studies, the second part of the monograph brings an outline of the clinical use of light with doses for each mentioned disease, expressed in S units. This is a temporary unit for practical use until an International unit has been adopted. A liberal number of illustrations adds much to the understanding of the author's work.

As stated in the preface, this monograph is only a preliminary communication written particularly for the purpose of acquainting other investigators with the method. It is the reviewer's opinion that every radiologist interested in the scientific application of radiation should study the work of Saidman because his method of approach seems to offer many possibilities both in the biologic and clinical phase of light research.

ERNST A. POHLE



## BOOKS RECEIVED

TUBERCULOSIS AMONG CHILDREN. By J. Arthur Myers, Ph.D., M.D., F.A.C.P., Chief of Medical Staff, Lymanhurst School for Tuberculous Children, Associate Professor of Preventive Medicine, University of Minnesota. Cloth. Pp. 208, with 43 illustrations. Springfield, Ill.: Charles C. Thomas, 1930.

ERGEBNISSE DER MEDIZINISCHEN STRAHLENFORSCHUNG (RONTGENDIAGNOSTIK, RONTGEN-, RADIUM- UND LICHTTHERAPIE). Band IV. Herausgegeben von H. Holfelder, Frankfurt a. M., H. Holthusen, Hamburg, O. Jüngling, Stuttgart, H. Martius, Göttingen, H. R. Schinz, Zürich. Paper, price M. 71; bound, price M. 74. Pp. 694, with 395 illustrations. Leipzig: Georg Thieme, 1930.

EXPERIMENTAL STUDIES ON ROENTGEN TREATMENT OF MALIGNANT TUMORS. (*Acta radiol., Suppl. IX.*) By Jens Juul. Paper. Price, Sw. cr. 8. Pp. 104, with illustrations. Stockholm: P. A. Norstedt & Soner, 1929.

THE EFFECT OF ROENTGEN IRRADIATION ON THE INTERRELATION BETWEEN MALIGNANT TUMORS AND THEIR HOSTS. (*Acta radiol., Suppl. VIII.*) By Carl Krebs. Paper. Price, Sw. cr. 8. Pp. 133, with illustrations. Stockholm: P. A. Norstedt & Soner, 1929.

ÉTUDE CLINIQUE ET RADIOLOGIQUE DES OSTEITES CONDENSANTES BENIGNES (OSTEITES PICNOTIQUES). By Docteur Paul-Marie Bernard, ancien externe des Hôpitaux de Paris. (Travail du Service du Professeur Sicard.) Paper. Pp. 119, with 35 illustrations. Paris: Grasse, Impressions "Frago," 1929.

ULTRA-VIOLET RADIATIONS AND THEIR USES. By Robert Aitken, M.D., F.R.C.P.E., Lecturer on Diseases of the Skin, Edinburgh University; Assistant Physician, Skin Department, and Physician in Charge Dermatological Light Department, Royal Infirmary, Edinburgh, etc. Cloth. Price, 18/6. Pp. 208, with 15 illustrations. Edinburgh: Oliver and Boyd, 1930.

ULTRA-VIOLET RAYS IN THE TREATMENT AND CURE OF DISEASE. By Percy Hall, M.R.C.S. (Eng.), L.R.C.P. (Lond.), Hon. Actino-therapist, the Mount Vernon Hospital, London and Northwood, Hon. Consulting Physician to the Hull Municipal Light Clinic, etc. Fourth edition. Cloth. Price, \$4.50. Pp. 248, with 64 illustrations. St. Louis: The C. V. Mosby Co., 1930.

X-RAY CRYSTALLOGRAPHY. By R. W. James, M.A., B.Sc., Senior Lecturer in Physics in the University of Manchester. Cloth. Price, \$1.15. Pp. 88, with 29 illustrations. New York: E. P. Dutton & Co., Inc., 1930.

MEDICAL AND SURGICAL YEAR-BOOK OF THE PHYSICIANS HOSPITAL OF PLATTSBURGH. Comprising Wednesday Afternoon Invitation Lectures; Papers of the Cardiac Round Table; The First Beaumont Lecture; Collected Papers by the Staff. Cloth. Price, \$3.50. Pp. 322, with numerous illustrations. Plattsburgh, N. Y.: The William H. Miner Foundation, 1930.

MERCK'S INDEX: AN ENCYCLOPEDIA FOR THE CHEMIST, PHARMACIST AND PHYSICIAN. Fourth edition. Cloth. Price, \$5.00 (discount of 50 per cent to members of and those affiliated with the medical, chemical, pharmaceutical and applied professions). Pp. 585. Rahway, N. J.: Merck & Co., Inc., 1930.



# INDEX TO ABSTRACTS

## ROENTGEN DIAGNOSIS

### Head

- FAY, TEMPLE: Generalized pressure atrophy of the brain secondary to traumatic and pathologic involvement of Pacchionian bodies. . . . . 324
- KRABBE, KNUD H., AND WISSING, OVE: Calcifications of the pia mater of the brain of angiomatic origin demonstrated by roentgenography. . . . . 324

### Neck and Chest

- PÉLISSIER, G.: A case of mega-esophagus. . . . . 324
- LAPEYRE: A case of anterior diverticulum of the esophagus. . . . . 324
- SURMONT, J., AND MAIRE: Cancer of the esophagus; pleural fistula. . . . . 324
- NAUMANN, H.: A case of calcified pleural thickening. . . . . 325
- JALET: Concerning a few cases of "accessory lobe of the azygos vein". . . . . 325
- JALET, J.: Does the demonstration of an azygos lobe represent an important sign of pachypleuritis? . . . . . 325
- BRADFORD, JOHN ROSE: Massive collapse of the lung. . . . . 325
- PINCHIN, A. J. S., AND MARLOCK, H. V.: Atelectatic bronchiectasis. . . . . 325
- ZORZOLI, P.: So-called tuberculous peribronchitis. . . . . 325

### Abdomen

- RADT, PAUL: A method for roentgen contrast visualization of the spleen and liver. . . . . 326
- SEMENZA, CARLO: Jejuno-colic fistula. . . . . 326
- FULLER, C. J.: Cholecysto-colic fistula with unusual radiographic findings. . . . . 327
- PFLAUMER: Cholecystographic and urologic diagnosis. . . . . 327
- GARCIN: Cholecystography; conclusions from a statistical study of 506 cases. . . . . 327
- SANDSTROM, CARL: Contribution to the roentgenological appearance in cases of benign diverticular growths of the stomach. . . . . 327
- DILLENSEGER: Three cases of so-called congenital diverticula of the duodenum. . . . . 327
- TESCHENDORF, WERNER: On the usefulness of roentgen signs in duodenal ulcer. . . . . 328
- LEDoux-LEBARD, JAHIEL, AND CALDERON, GARCIA: Observation on multiple diverticula of the colon. . . . . 328
- LAURELL, HUGO: Roentgen examination of hernias, particularly forms that are hard to diagnose clinically. . . . . 328

## Gynecology and Obstetrics

- JIANU, ST. I.: Some data on uterosalpingography. . . . . 329
- SURMONT, JEAN: Lipiodol diagnosis of a tumor of the uterus. . . . . 329

## Genitourinary System

- KNUTSSON, FOLKE: On the technique of urethrography. . . . . 329
- POLLACK, HERBERT: A new adjuvant for the elimination of the disturbing meteorism in kidney roentgenography. . . . . 329
- ARNTZEN, LEIF, AND WÖRNING, BORGE: A case of double renal pelvis and double ureter in both sides. . . . . 330
- JUDD, E. STARR, AND GRIER, JAMES P.: Multiple malignant adenomas of the kidney. . . . . 330

## Skeletal System

- CASATI, A.: Interpretation of the roentgenogram in bone diseases. . . . . 330
- ROGERS, HERBERT: A case of solitary plasmacelled myeloma. . . . . 331
- JUNGHAGEN, SVEN: Spondylitis deformans with cord symptoms. . . . . 331
- DOUARRE: Two cases of Recklinghausen's disease. . . . . 332
- FAIRBANK, H. A. T.: Congenital dislocation of the hip; with special reference to the anatomy. . . . . 332
- PASCHETTA, VINCENT: Diagnosis of impaction of fractures of the neck of the femur by means of roentgenograms in three positions. . . . . 332
- RENANDER, AXEL: Anomalies roentgenologically observed of the cranio-vertebral region. . . . . 333
- RENANDER, AXEL: Disturbances of development of the spinal column; somatoschisis; hemispondylus. . . . . 333
- SMITH, S. WATSON: Kummell's disease. . . . . 333
- ROEDERER, C., AND CHARLIER: A rare case of anomaly of the sacrum. . . . . 333

## ROENTGEN AND RADIUM THERAPY

- STUMPKE, G.: Results of roentgen treatment in skin cancer. . . . . 333
- FUHS, H., AND KONRAD, J.: On experiences with indirect roentgen irradiation of skin diseases. . . . . 334
- GRUTZ, O.: Roentgen castration in impetigo herpetiformis. . . . . 334
- ROHRBACH, R.: Roentgen treatment of chronic paronychia. . . . . 334

- BECK, A.: Roentgen therapy of bone metastases in mammary carcinoma. . . . . 334
- FUHS, HERBERT: General roentgen irradiation with very small doses in skin diseases. . . . 335
- v. JASCHKE, R. T.: The chief point in the struggle against cancer of the uterus. . . . 335
- RITTER, H., AND KARRENBERG, C. L.: Should thallium or roentgen rays be used for epilation? . . . . . 335
- HABERMANN, R.: Roentgen injury after epilation in a child with heavy metal filtration, and medicolégál judgment on it. . . . . 336
- SCHOENHOLZ, L., AND HIRSCH, H.: Histochemical examinations of carcinoma before and after irradiation. . . . . 336
- BRANDT, W.: Treatment of lupus vulgaris. . . . 336
- JOSEPH, EUGEN: The treatment of malignant tumors with radium catgut. . . . . 337
- HALBERSTAEDTER, L., AND SEIFFERT, A.: Radiation treatment of laryngeal carcinoma. . . . 337
- GASK, G. E.: Treatment of epithelioma of the tongue by radium. . . . . 337
- CARLING, FRANCIS ROCK: Radium teletherapy. . . . 337
- JACOBS, J.: Irradiation of lymphogranulomatosis. . . . . 338
- KONRAD, JOSEF: Treatment results with Bucky borderline rays in dermatology. . . . . 338
- BORAK, J.: The analgesic effects of roentgen rays with especial consideration of bone metastasis of cancer. . . . . 338
- TOWNE, EDWARD B.: Treatment of pituitary tumors; the rôle of the röntgen-ray and of surgery therein. . . . . 338
- MOGILNITZKY, B. N., AND PODLJASCHUK, L. D.: The effect of roentgen rays on the central nervous system. . . . . 340
- MOGILNITZKY, B., AND PODLJASCHUK, L.: Roentgen rays and the so-called "hematoencephalic barrier". . . . . 340
- GABRIEL, G.: Effect of roentgen rays on the vegetative nervous system. . . . . 341
- PFÄHLER, GEORGE E., AND PARRY, LEO D.: Results of roentgen therapy in carcinoma of the breast. . . . . 341
- VON AMMON, ERNST: Results of radiotherapy in myomas of the uterus and hemorrhagic metropathies. . . . . 341
- FÜRST, WALTER: Dosage of hard roentgen rays from distant fields in the treatment of carcinoma of the cervix. . . . . 342
- FÜRST, WALTER: Dosage of hard roentgen rays from distant fields in the treatment of carcinoma of the cervix. . . . . 342
- BOWING, HARRY H., AND FRICKE, ROBERT E.: Results obtained in the treatment of carcinoma of the cervix uteri with radium and x-rays. . . . . 343
- ST. SIMON: Intrauterine use of radium. . . . . 343
- BINKLEY, GEORGE E.: Advantages and limitations of radiation in the treatment of rectal cancer. . . . . 343
- BOWING, H. H., FRICKE, R. E., AND SMITH, N. D.: Treatment of malignant tumors of the rectum by radium and roentgen rays. . . . 343
- HIRSCHBERG, M.: Permanent cure of a sarcoma of the tibia with roentgen rays and atrophy of the irradiated muscles. Late atrophy of the muscles of the neck after superficial roentgen irradiation fifteen years before. . . . . 343
- MISCELLANEOUS
- NEMENOW, M. I.: The State Institute for Roentgenology, Radiology and Cancer Research in Leningrad. . . . . 344
- HERZ, RICHARD: A check-up of the time of exposure in diagnostic apparatus. . . . . 344
- DIACLÈS: The reading of stereograms with the aid of binoculars. . . . . 345
- BRAUN, OSKAR: The analytic field selector. . . . 345
- FERNAU, ALBERT: How to make radium carriers. . . . . 345
- RISSE, O.: Mechanism of chemical roentgen reactions in aqueous solutions. . . . . 345
- DEL BUONO, P.: Further studies of the effect of roentgen rays on the vegetative nervous system. . . . . 346
- JUGENBURG, ANNA: Effect of roentgen irradiation on basal metabolism. . . . . 346
- RUBINSTEIN, D. L.: Studies of roentgen sensitization. I. The mechanism of sensitization by iodine salts. . . . . 347
- SCHREUS, H. TH.: The destruction of cholesterol by means of roentgen rays in vitro. . . 347
- BECKWITH, T. D., OLSON, A. R., AND ROSE, E. J.: The effect of x-ray upon bacteriophage and upon the bacterial organism. . . . 347
- WYCKOFF, RALPH W. G., AND RIVERS, THOMAS M.: Effect of cathode rays upon certain bacteria. . . . . 348

## ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

### ROENTGEN DIAGNOSIS

#### HEAD

FAY, TEMPLE. Generalized pressure atrophy of the brain secondary to traumatic and pathologic involvement of Pacchionian bodies. *J. Am. M. Ass.*, Jan. 25, 1930, 94, 245-249.

Cerebral trauma of varying severity is frequently followed by a train of indefinite central nervous system disorders which present no localizing signs. Commonly these phenomena are the result of pressure atrophy of the fronto-parietal region of the cerebrum due to interference with the free absorption of cerebrospinal fluid by the subarachnoid villi and pacchionian bodies which were injured by the red blood cells in the cerebrospinal fluid at the time of injury. The diagnosis is made by encephalography.

In traumatic cases the presence of red blood cells in the cerebrospinal fluid calls for removal by repeated drainage by lumbar puncture from once to three times daily up to the fifth to seventh day.

Acute cerebral trauma cases are treated as follows: (1) By surgery; (a) compound fracture; (b) depressed fracture giving localizing signs; (c) middle meningeal hemorrhage or focal clot. (2) By dehydration or drainage or both. Cases with generalized pressure symptoms without focal signs.

The technique in the latter group is briefly: (1) Treatment for shock. (2) Neurological examination, including palpation of skull. (3) Lumbar puncture to determine presence and character of fluid. Bloody fluid indicates drainage. Pressure is controlled by limited fluid intake and magnesium sulphate by rectum. Equilibrium is maintained in the presence of shock by a carefully adjusted combination of these agents with 50 per cent glucose and physiological sodium chloride and glucose intravenously. (4) Roentgen examination on admission is of least importance except in evidently depressed or compound fractures. Otherwise it should wait until the patient is out of danger. Even in cases of demonstrable fracture by roentgenogram, operation should

be based primarily upon neurological signs. (5) Restricted fluid intake is enforced for three months following injury and a limit of 2000 c.c. daily is prescribed for the future.—*G. R. Miller.*

KRABBE, KNUD H., and WISSING, OVE. Calcifications de la piemère du cerveau d'origine angiomeuse démontrée par la radiographie. (Calcifications of the pia mater of the brain of angiomatous origin demonstrated by roentgenography.) *Acta radiol.*, 1929, 10, 523-532.

Four cases and roentgenograms of the surface of the brain are reproduced. They show a shadow corresponding exactly to the convolutions and fissures of the brain which the author calls a gyriform shadow. Three of the patients, like those previously described in the literature, had vascular naevi, "wine-spots," of the face. The brain shadows are probably caused by calcified angiomas of the pia mater. About 10 similar cases have been described in the literature.—*Audrey G. Morgan.*

#### NECK AND CHEST

PELISSIER, G. Un cas de méga-oesophage. (A case of mega-esophagus.) *Bull. et mém. Soc. de radiol. méd. de France*, Dec., 1929, 17, 315-316.

An unusual case of mega-esophagus (in a man sixty-five years of age) is briefly described. The dilatation of the esophagus was so pronounced that it gave the impression of a veritable intrathoracic stomach. In spite of this enormous extent of the lesion the patient had practically no complaint.—*T. Leucutia.*

LAPEYRE. Un cas de diverticule antérieur de l'oesophage. (A case of anterior diverticulum of the esophagus.) *Bull. et mém. Soc. de radiol. méd. de France*, Dec., 1929, 17, 318-319.

A diverticulum localized to the anterior aspect of the esophagus (at the level of the concavity of the aortic arch) was observed in a man fifty-six years of age. The condition is extremely rare.—*T. Leucutia.*

SURMONT, J., and MAIRE. Cancer de l'oesophage. Fistule pleurale. (Cancer of the esophagus; pleural fistula.) *Bull. et mém.*



*Soc. de radiol. méd. de France*, Jan., 1930, 18, 35-36.

A cancer of the esophagus perforated into the pleural cavity, leading to the passage of the barium meal into the right costodiaphragmatic sinus. The patient died within a few hours following the examination and the autopsy revealed a pleural fistula from a primary carcinoma of the esophagus.—*T. Leucutia*.

NAUMANN, H. Ueber einen Fall von verkalkter Pleuraschwarte. (A case of calcified pleural thickening.) *München. med. Wchnschr.*, Feb., 14, 1930, 77, 279-280.

A case of calcification of the pleura observed in a man sixty-seven years of age, who three years previously suffered from an acute pleuritis, is briefly described and the roentgenograms in posteroanterior and lateral views reproduced.—*T. Leucutia*.

JALET. A propos de quelques cas de "lobe accessoire de la veine azygos." (Concerning a few cases of "accessory lobe of the azygos vein.") *Bull. et mém. Soc. de radiol. méd. de France*, Dec., 1929, 17, 281-285.

Sixteen cases of azygos lobe were observed by the author in a total of 1600 examinations. In 2 cases the condition was detected at roentgenoscopy.

The author proposes the term of "tearshaped" shadow instead of the "comma-shaped" shadow of the Anglo-Americans for the designation of the characteristic roentgen image of the reduplication of the pleura which at one end incloses the vena azygos (appearing in cross section on the roentgenogram).

The reduplication of the pleura may be the seat of collections of pachypleuritis. It is probable that many of the peculiar bands observed in the region of the right upper lobe represent the sequelae of such a pachypleuritis.—*T. Leucutia*.

JALET, J. La constatation d'un lobe accessoire de la veine azygos, a-t-elle la valeur d'un signe important de pachypleurite? (Does the demonstration of an azygos lobe represent an important sign of pachypleuritis?) *Presse méd.*, May 7, 1930, 38, 625-627.

On the basis of a study of 16 cases of azygos lobe which were reported previously (see above abstract) the author is of the opinion that the visualization of the reduplicated pleura (meso-

azygos) of the azygos lobe does not signify a pathological condition. It is a generally accepted rule that every pleura which is visible on the roentgenogram is pathological, but this does not hold true for the azygos lobe since here, because of the reduplication, there are four pleural layers producing a thickness sufficient to cast a shadow on the roentgen film.

The knowledge of the pleural reduplication of the azygos lobe, however, is important since it may form the site of an encysted collection in localized pachypleuritis (with or without association of parenchymal lesions) and may indicate the extension of the infection in a generalized pleuritis.—*T. Leucutia*.

BRADFORD, JOHN ROSE. Massive collapse of the lung. *Lancet*, Feb. 15, 1930, 1, 331-334.

Massive pulmonary collapse is seen in military and civil practice. Its frequency cannot be stated because it is often overlooked. Two causes probably exist. One is palsy of the respiratory muscles; the other is bronchial obstruction. The physical findings are characteristic of three stages: (1) Weak breath sounds, immobility of chest, high diaphragm and displaced mediastinal viscera. (2) Tubular breathing replaces the weak breathing. (3) Crepitation and rales occur. The symptoms are variable. Dyspnea is the commonest subjective sign, but it is to be stressed that considerable pulmonary involvement may result in but slight dyspnea. The involvement is usually basal, rarely bilateral. Physical signs change rapidly as does the underlying condition. There may be inflammatory complications.

The mechanism of production probably is a reflex splinting of the muscles of respiration with a consequent rapid absorption of intrapulmonary air and the formation of bronchial obstruction by mucus and exudate.—*G. R. Miller*.

PINCHIN, A. J. S., and MARLOCK, H. V. Atelectatic bronchiectasis. *Brit. M. J.*, Jan. 4, 1930, 1, 12-13.

In roentgenograms of the chest a triangular density with one side along the mediastinum, the other on the diaphragm, and the hypotenuse extending from mediastinum to diaphragm, may be due to mediastinal effusion or to atelectasis. This area is one of little respiratory movement and favors residual ate-

lectasis. Within the atelectatic area bronchiectasis may frequently be demonstrated by lipiodol injection. Tuberculous mediastinal effusion was responsible for the triangular shadow in one case and atelectatic bronchiectasis in 4 cases.—*G. R. Miller.*

ZORZOLI, P. La questione delle cosiddette peri-bronchiti tubercolari. (So-called tuberculous peribronchitis.) *Radiol. med.*, Feb., 1930, 17, 166-185.

The pulmonary striation described by Sturz has heretofore been considered, and by some still is, as a sign of peribronchial lymphangitis and an early symptom of beginning tuberculosis. But some authors say that these stripes do not have any pathognomonic value and are only the pictures of the pulmonary vessels. The author from his study of the subject concludes that the stripes may be either the picture of the vessels or a sign of peribronchial tuberculosis. But the vessel stripes have special characteristics by which they may be recognized. In peribronchial tuberculosis, pathological anatomy and clinical roentgen examination both show signs of productive processes in the walls of the bronchi which make it possible to differentiate these pictures from the vessel stripes. The author also finds that the peribronchial stripes are seen not only in beginning infiltration but also in the late and even the terminal stages of pulmonary tuberculosis.—*Audrey G. Morgan.*

#### ABDOMEN

RADT, PAUL. Eine Methode zur röntgenologischen Kontrastdarstellung von Milz und Leber. (A method for roentgen contrast visualization of the spleen and liver.) *Klin. Wchnschr.*, Nov. 12, 1929, 8, 2128-2129.

Three c.c. of tordiol (thorium dioxide sol) was injected intravenously into rabbits of 2500 to 3000 gm. weight (0.2 to 0.25 gm. thorium dioxide per kilogram body weight) and in all instances the liver and spleen were well visualized roentgenologically. The method as first used was very toxic and led to numerous cases of paresis with subsequent death. Later, however, a procedure was worked out by which the animals could support the injection without disturbance.

The method is not applicable to humans as

yet. Further experiments are in course.—*T. Leucutia.*

SEMENZA, CARLO. Le fistole digiuno-coliche. (Jejuno-colic fistula.) *Radiol. med.*, Feb., 1930, 17, 125-139.

The literature on the subject of jejuno-colic fistula is reviewed. Most of these fistulas are secondary to peptic ulcer of the jejunum following gastroenterostomy; some of them are caused by tumor. The most important clinical symptoms are emaciation, dysentery, fecaloid vomiting and pain. The author describes a case in a young man of twenty-one in which the clinical symptoms were not sufficient for diagnosis which had to be made from the roentgen examination. The stomach was normal and its motor function active. The contrast medium passed normally through the duodenum and the first loop of the jejunum but in the left upper quadrant there was a large shapeless spot which seemed to envelop two or three segments of intestine; this was at the same site as a resistance that had been palpated clinically and both the spot and the resistance were movable; almost at the same time there was filling of the middle and proximal thirds of the transverse colon and of the distal half of the descending colon. In two hours and a half the stomach was empty; there was still barium in the proximal loops of the jejunum to the abnormal spot; all the rest of the barium was in the large intestine and there was none in the ileum. In the middle of the transverse colon there was a cord-like constriction; this constriction was to the median side of the abnormal spot and in contact with the mass that could be felt clinically. An opaque enema confirmed these signs of jejuno-colic fistula. Operation showed a lymphosarcoma that involved the transverse colon and a loop of the jejunum. The patient recovered and was dismissed well on July 16. He was well for a few months but there was recurrence in the retroperitoneal glands and he died on Dec. 12.

Roentgen examination is invaluable in these cases as it shows passage of the opaque medium from the stomach into the colon and of an opaque enema into the stomach. It is particularly valuable as it is the only means of making an early diagnosis before the patient is reduced to such a condition of cachexia that he cannot bear operation.—*Audrey G. Morgan.*

FULLER, C. J. Cholecysto-colic fistula with unusual radiographic findings. *Brit. M. J.*, Feb. 15, 1930, 1, 279-280.

A woman aged sixty-nine had had right upper abdominal pain and a smooth tumor six years previously. Gastrointestinal roentgenograms were negative. A diagnosis of cholecystitis with a Riedel's lobe was made. Recently, following severe griping pains in the abdomen, a barium meal and a barium enema showed communication between duodenum, colon, and biliary passages, including the intrahepatic bile ducts. The right upper quadrant tumor was absent. On neither occasion had jaundice been present. There are three possible explanations: (1) one large stone passed into the duodenum and then ulcerated into the colon; (2) one of two stones ulcerated into the duodenum at the first attack, and the other into the colon at the second; (3) a stone ulcerated from the biliary passages into the colon, damaging the subjacent duodenum in its passage. The last is probably correct, the stone having ulcerated through the neck of the gall-bladder. The free communication between colon and intrahepatic bile ducts caused no evident ill effect.—G. R. Miller.

PFLAUMER. Cholezystographie und urologische Diagnostik. (Cholecystographic and urologic diagnosis.) *München. med. Wchnschr.*, Feb. 7, 1930, 77, 236-239.

It is advised that in case of severe pain in the right upper abdomen the urologic examination (ureteral catheterization, pyelo-ureterography and pyelo-ureteroscopy) be preceded by a roentgen examination of the gall-bladder. A flat film as a rule helps to demonstrate at least 40 per cent of the gallstones, while cholecystography by means of a contrast medium adds 30 per cent more. The procedure is recommended especially in floating kidneys, doubtful enlargements of the kidney pelvis, ureteral kinkings and in stenosis.

By following this method, many unnecessary operations may be avoided.

The article is illustrated with 11 beautiful roentgenograms.—T. Leucutia.

GARCIN. La cholecystographie. Les conclusions d'une statistique de 506 cas. (Cholecystography; conclusions from a statistical study of 506 cases.) *Bull. et mém. Soc.*

*de radiol. méd. de France*, Dec., 1929, 17, 336-338.

Of 506 cases examined by the oral method of cholecystography, in 422 there was visualization of the gall-bladder, in 26 the gall-bladder was invisible but there was evidence of stones and in 58 the gall-bladder remained invisible. Positive information was gained in 88 per cent of the cases.—T. Leucutia.

SANDSTROM, CARL. Contribution to the roentgenological appearance in cases of benign diverticular growths of the stomach. *Acta radiol.*, 1929, 10, 427-436.

The author describes a case interesting from the point of view of differential diagnosis, in which roentgen examination of the stomach showed a narrowing of the lumen of the pylorus, which was of the nature of a defect and in the center of which there was a niche-like opaque spot. From the roentgen picture a tentative diagnosis was made of ulcer surrounded by infiltration. Operation showed a benign tumor-like hyperplasia of the pyloric glands in the submucosa and muscularis, surrounding a central diverticulum, that is, a diverticular adenoma, or as a more correct term, on account of the character of the glands: adenomatosis combined with diverticulum.

Such benign diverticular tumors (diverticular myomata or adenomata) are very rare and only one case has previously been described in the literature in which roentgen examination was made. In that case, as in this one, the roentgen findings were incorrectly interpreted. On account of the presence of both diverticulum and tumor in these cases it is difficult to make a roentgen diagnosis. The picture is that of a niche-like opaque spot surrounded by a defect in the contrast shadow, a picture that is typical of ulcer surrounded by infiltration (callous or cancerous). In cases in which ulcer or cancer is suspected for clinical reasons, it is almost impossible to exclude ulcer. To make a correct diagnosis a series of examinations must be made for some time, possibly after an ulcer treatment, after which the changes should remain stationary. In these cases the absence of spasm is an argument against ulcer, another being absence of blood in the feces.—Audrey G. Morgan.

DILLENSEGER. Trois cas de diverticules dits congénitaux du duodénum. (Three cases of

so-called congenital diverticula of the duodenum.) *Bull. et mém. Soc. de radiol. méd. de France*, Jan., 1930, 18, 28-32.

In connection with 3 cases of diverticula of the duodenum, which are briefly described (one case with complicating ulcer of the bulb), the author expresses the opinion that duodenal diverticula are most probably the result of congenital predisposition. Lesions or functional disturbance of the neighboring organs lead to their development.—*T. Leucutia*.

TESCHENDORF, WERNER. Ueber die Bewertung der Röntgenzeichen des Zwölffingerdarmgeschwurs. (On the usefulness of roentgen signs in duodenal ulcer.) *Klin. Wchnschr.*, Feb. 22, 1930, 9, 359-365.

On the basis of a series of 572 cases of duodenal ulcer, 68 of which came to operation, the author expresses the following opinion concerning the practical value of the various roentgen signs. The most important and reliable sign is the duodenal niche which occurred in 260 of the cases examined. The niches of the so-called *en face* ulcers, which are localized to the anterior or posterior walls of the duodenum, are often evidenced only by special procedures. The pocket or diverticular formations, the deformities of the duodenal bulb (megabulbus, phthisis bulbi), the normal appearance of the duodenal bulb with five hour gastric residue (due to thickened pyloric ring) and the demonstration of periduodenal adhesions are often of great value in substantiating the roentgen diagnosis of a duodenal ulcer, yet according to the author's estimation operative indications should not be established purely on roentgen findings. In this respect, though it is admitted that the roentgen procedure leads to the detection of many complications and establishes anatomic criteria in the most precise way, the clinical findings are of greater aid.—*T. Leucutia*.

LEDoux-LEBARD, JAHIEL, and CALDERON, GARCIA. Observation de diverticules multiples du colon. (Observation on multiple diverticula of the colon.) *Bull. et mém. Soc. de radiol. méd. de France*, Jan., 1930, 18, 27-28.

The authors present an additional case of multiple diverticula of the colon which in spite of repeated roentgen examinations remained long undiagnosed. The authors ad-

ministered three consecutive opaque meals, 18, 13 and 9 hours previous to the examination, and took films at 9, 24, 36 and 60 hours following the last meal. The films which show a very clear outline of the diverticula are reproduced.—*T. Leucutia*.

LAURELL, HUGO. Ueber die Röntgenuntersuchung von Bruchen, insbesondere klinisch schwer zu diagnostizierenden Formen. (Roentgen examination of hernias, particularly forms that are hard to diagnose clinically.) *Acta radiol.*, 1929, 10, 462-498.

When roentgen examination has been made in hernia heretofore it has generally been for information in regard to the contents of the sac. The contrast meal, enema and cystography have been used. Roentgen examination is also useful in studying the morphology of the hernial sac and ring. In cases of hernia that can be diagnosed clinically roentgen examination is of no practical value except in examining a clinically doubtful condition of ileus in which strangulation is suspected. Two cases of the latter kind are described: one a femoral hernia, the other an obturator hernia, both being Richter's hernias. The examination in such cases is usually made without any contrast medium. Sometimes, however, when there are no gas bubbles in the small intestine, a few spoonfuls of contrast meal will serve to locate any partial obstruction in the small intestine.

But roentgen examination is of great value in proving the existence of clinically doubtful or non-demonstrable, non-strangulated internal or external hernia. In such cases the contrast meal, or more rarely an enema, is used. The hernial regions are examined from two to seven hours after the contrast meal; loops or smaller parts of intestine projecting from the normal intestinal area and suspected of lying in a hernial sac are more definitely located under the fluoroscope. Examination is then made to see whether under increased intra-abdominal pressure they penetrate farther into the suspected opening. If that is the case the diagnosis of hernia is clear. The roentgen picture of a small hernia at the inguinal region may not be sufficiently characteristic to make the determination of its exact nature immediately possible; in such cases palpation under the fluoroscope must be used. An indirect inguinal hernia and an obturator hernia will give a typical picture



in the early stages. Illustrative cases are described.

Incomplete external hernia is of course often seen as a precursor to complete hernia. The symptoms may be so vague as to make the diagnosis uncertain. The diagnostic value of roentgen examination in cases of that kind is illustrated, for instance, by an unusual case of properitoneal hernia, which had been seen roentgenologically but wrongly interpreted as an inguinal hernia or the beginning of one; and also by a case of incomplete indirect inguinal hernia with pronounced chronic obstruction of the small intestine. The hernia could not be demonstrated clinically in either case. The last-mentioned one proved on operation to be a reducible hernia but with slight adhesions around the loop of intestine. It is possible that these adhesions were the result of an earlier strangulation that had been reduced spontaneously. A chronic appendicitis with adhesions in the immediate neighborhood may also probably result from repeated strangulation. Therefore in any case of operation for suspected appendicitis the hernial regions near the appendix should be examined from the abdomen; if the examination shows an open hernial ring it should if possible be closed when the appendectomy is performed. In doubtful abdominal cases the roentgenologist should always remember to examine the hernial region when giving a contrast meal. Whether the hernia is large or small, free or irreducible, the passage through the small intestine will often be retarded, though generally only slightly. A small residue in the lower ileum after nine hours and a slight liquid level in the small intestine are often seen. In case of strangulation and other complications the passage is of course still more difficult, or even completely obstructed. If the transverse colon lies in the inguinal hernia the stomach may be pulled out lengthwise; if the stomach itself has become involved in the hernia narrowing of the hernial ring may give it an hour-glass shape.—*Audrey G. Morgan.*

#### GYNECOLOGY AND OBSTETRICS

JIANU, ST. I. Câteva date asupra uterosalpingografiei. (Some data on uterosalpingography.) *Cluj. med.*, Feb., 1930, 11, 74-78.

Uterosalpingography has been used routinely

at the surgical clinic of the University of Cluj since 1926. After a description of the technique of injection, which in general corresponds to that used by Cotte, the author briefly describes 8 cases, some of them with unusual findings, in order to prove the value of the method. The conclusion is reached that the method is entirely harmless. It is indicated in malformations, tubal lesions, especially tubal obstruction and as a control procedure of certain operations such as salpingostomy, tubal uterine implantation and myohysteropexy (according to Iacobovici).—*T. Leucutia.*

SURMONT, JEAN. Lipiododiagnostic d'une tumeur de l'utérus. (Lipiodol diagnosis of a tumor of the uterus.) *Bull. et mém. Soc. de radiol. méd. de France*, Jan., 1930, 18, 33-34.

The injection of the uterine cavity with lipiodol led to the correct diagnosis of fibroma of the uterus in a woman forty years of age. There was only slight distortion of the uterine cavity but the lead wire method permitted the detection of a lateral displacement. There was also elongation of one of the tubes.—*T. Leucutia.*

#### GENITOURINARY SYSTEM

KNUTSSON, FOLKE. On the technique of urethrography. *Acta radiol.*, 1929, 10, 437-441.

After having briefly reviewed the method used in urethrography, the author describes a penis clamp made for that particular purpose. The clamp makes the examination simpler and more convenient. He also discusses the so-called supra-collicular elongation of the posterior urethra. In contradiction with Dressler, the author holds that only the 1-2 cm. of the shadow above the colliculus seminalis is caused by the urethra and that the remaining part of it is caused by some of the opaque fluid collecting in a fold of mucous membrane at the bottom of the bladder. The elongation of the urethra is thus as a rule only apparent and no importance can be ascribed to it in estimating the size of the prostate gland. The paper is illustrated by a few urethrograms.—*Audrey G. Morgan.*

POLLACK, HERBERT. Ein neues Hilfsmittel zur Beseitigung des störenden Meteorismus in der Nierenrontgenographie. (A new adjuvant for the elimination of the dis-

turbing meteorism in kidney roentgenography.) *Klin. Wchnschr.*, Jan. 11, 1930, 9, 69-71.

The author suggests the use of "enzypan" for the elimination of gas preparatory to roentgen examination of the urinary tract. This preparation contains various enzymes necessary for the stimulation of the digestion in the gastric and intestinal tracts. It is made in the form of a dragé, the outer layer of which contains the gastric ferments consisting of a mass soluble in acid, while the inner layer, which contains the intestinal pancreatic ferments, consists of a substance which is soluble in the alkaline juices. Two to three tablets are taken three times daily following each meal for a period of three days. The evening of the third day a cathartic and the morning of the fourth day three enzypan tablets (on an empty stomach) are taken. Half an hour previous to the examination an enema is given. The method which was used in about 40 cases led to satisfactory results in two-thirds of the cases, while in one-third it was of no value.—T. Leucutia.

ARNTZEN, LEIF, and WORNING, BORGE. A case of double renal pelvis and double ureter in both sides. *Acta radiol.*, 1929, 10, 499-501.

A case is described and illustrated with roentgenograms. The patient was a woman aged forty-eight, who was taken ill six weeks before she came to the hospital with pain in the right kidney region.

Temperature, 38°; no dysuria, no hematuria. Right kidney enlarged, containing albumin and pus. Roentgen examination showed a deep shadow inside the right kidney shadow at the level of the 3d and 4th lumbar vertebrae. Its form was exactly that of the renal pelvis and calyces. When seen in lateral projection it lay in the same frontal plane as the spinal column; in oblique projection its place in the kidney shadow remained unchanged. It was without doubt a calculus completely moulded to the pelvic cavity and calyces. Both kidney shadows, particularly the right one, seemed extraordinarily long; the concrement-filled pelvis lay below the middle of the right kidney shadow. A second examination was therefore made with an opaque ureteral catheter. Cystoscopy showed the mucous membrane

of the bladder normal. On injection of indigo-carmin two ureteral orifices were found on each side, the anterior one 0.5 cm. nearer the midline than the posterior one. They were all easily catheterized for their full length and the urine drained from both those on the left side and the anterior one on the right side. The urine from the left side was normal; that from the right contained albumin, leucocytes and gram-positive cocci. As the distance between the two pelves on this side was only about 2 cm. heminephrectomy was out of the question. Nephrectomy was therefore performed. Recovery was uneventful.

Cases of double pelvis and ureter on one side are by no means rare but this anomaly on both sides is unusual. When there are two ureters on the same side the one from the upper pelvis generally opens into the bladder anteriorly and medially from the one belonging to the lower pelvis.—Audrey G. Morgan.

JUDD, E. STARR, and GRIER, JAMES P. Multiple malignant adenomas of the kidney. *Arch. Surg.*, Feb., 1930, 20, 240-245.

A case which came to operation is reported. The patient had a large mass in the left side of the abdomen. A pyelogram showed signs of compression of the lower half of the pelvis, with upward and inward displacement. Renal function was normal on both sides. A total nephrectomy was done. The adenomas were multiple, varying from 0.5 to 12 cm. in diameter. These tumors are mildly malignant but have not been seen to metastasize.—P. A. Bishop.

#### SKELETAL SYSTEM

CASATI, A. Come va interpretato il radiogramma di un affezione ossea? (Interpretation of the roentgenogram in bone diseases.) *Radiol. med.*, Jan., 1930, 17, 49-56.

The author makes a distinction between the primary essential symptoms of a bone disease and the secondary concomitant symptoms. For instance in a tuberculous bone there is a tuberculous sequestrum or a focus of granulation, shown in the roentgenogram by rarefaction. This is a characteristic of the disease itself. But later other changes appear, such as atrophy or a layer of sclerotic bone. These are not symptoms of the tuberculosis in itself but are signs of reaction in the surrounding bone which may eventually produce sequestra that are not specifically tuberculous.

This reactive capacity on the part of the bone has a great deal to do with the roentgen picture and explains why the roentgen pictures are often so different in the same disease. There are various factors that affect the reactive capacity, such as age, function, duration of the disease, tendency to chronicity, etc. The roentgen picture of a given disease, such as tuberculosis or rickets, will be different in a young person and an old one, a bone that is functioning or one that is not functioning and in a bone in which the course of the disease is rapid or chronic, that is, depending on the virulence of the virus. This makes it extremely difficult to describe the bone picture of any disease in the roentgenogram. The author then gives an interpretation of the symptoms in some bone diseases in accordance with these facts. For instance in osteomyelitis there is sclerosis in young subjects, indicating a reaction of the part of normal tissue. In old patients there is no sclerosis because there is little capacity for apposition. The sclerosis is greater in the cortex than in the center of the bone because the capacity for proliferation is greater there. The longer the duration of the disease, the greater the sclerosis. Independently of age, localization and duration of the disease, there may be no sclerosis in poor conditions of nutrition, for example, in osteomyelitis after severe typhoid followed by cachexia.—*Audrey G. Morgan.*

ROGERS, HERBERT. A case of solitary plasma-celled myeloma. *Brit. J. Surg.*, Jan., 1930, 17, 518-522.

Rogers reports a case of myeloma of the plasma-celled type showing only one solitary focus of new growth. Multiple myeloma of the plasma-celled type is of comparatively common occurrence, but cases showing a solitary focus of growth are rare. The patient was admitted to the hospital for a fusiform swelling of the front and inner aspects of the right thigh. The swelling was firmly attached to the bone and showed a semi-solid consistency. No egg-shell crackling could be elicited. The roentgen examination showed a honeycombed appearance in a mass of callus uniting an old fracture, and a rarefaction of the bone extending a short distance above and below the site of injury. There was a history of fracture of the right femur eight months previous to admission. After three operations at several months' in-

tervals, consisting of attempts to shell out the tumor mass, amputation was finally performed. Each operation had been followed by a recurrence of the growth. The pathological examination of the tissue removed at the operations showed a plasma-celled myeloma.

Rogers states that solitary plasma-celled myeloma is a new growth which arises in the bone marrow, and appears to occur more frequently in the long bones than in flat bones or vertebrae. The origin of the tumor is still a matter of dispute; the type cell is believed to be derived either from a lymphocytic cell or from the perivascular endothelium. Ewing's tumor may be mistaken sometimes for myeloma when sections are overstained with hematoxylin. Plasma cells may be found in Ewing's tumor which also makes the diagnosis more difficult.

This patient received radium before the first and second operations. It seems probable that the use of radium, as observed in this case, in large doses, may bring about a condition of radium necrosis, which not only prevents any attempt at recurrence on the part of the tumor tissue but also places the natural reparative reactions in obedience. The possibility of such an eventuality must be kept well in mind when radium is employed, as the clinical evidence of the necrotic influence may be delayed for ten days or a fortnight.—*R. S. Bromer.*

JUNGHAGEN, SVEN. Spondylitis deformans mit medullaren symptomem. (Spondylitis deformans with cord symptoms.) *Acta radiol.*, 1929, 10, 535-538.

A case is described in a man of sixty-six who for six months had had paresthesias in the shape of a feeling that his legs had gone to sleep and had had difficulty in walking. Examination showed no signs of brain disease but there were several symptoms, including a positive Babinski, which indicated disease of the spinal cord and the lumbar roots. The clinical picture, the lack of other symptoms, the absence of a Wassermann reaction and the roentgen findings in the spinal column and subarachnoid space indicate decidedly that this condition was caused by the intense spondylitis deformans from which the patient suffered. Other cases of spondylitis with neurological symptoms have been described, but they were all of the root type, with root pain

and atrophic pareses, caused by periosteal deposits which extended over the intervertebral foramina and more or less occluded them. In this case, too, there were root symptoms but the decreased pain and temperature sensation on the outer side of the spinal column and the other cord symptoms mentioned above could not be explained in this way. They were probably caused by the inelastic intervertebral discs being pushed into the vertebral canal and forming large cartilaginous exostoses there. There were periosteal deposits on the posterior outlines of the bodies of the vertebrae but they were not large enough to have caused the great changes in the myelogram. The exostoses formed incisures in the subarchnoid space and cord. The picture of spondylitis deformans differs greatly from the normal picture for while in the latter there are traces of incisures in the opaque column they are at the middle of the vertebrae between the intervertebral discs, while in spondylitis deformans they are at the site of the intervertebral discs. The exostoses may become large enough to occlude the ventral part of the subarchnoid space and simulate tumor. But the multiplicity of the changes and their position with reference to the intervertebral discs make differentiation possible.—*Audrey G. Morgan.*

DOUARRE. Sur deux cas de maladie de Recklinghausen. (Two cases of Recklinghausen's disease.) *Bull. et mém. Soc. de radiol. méd. de France*, Dec., 1929, 17, 338.

The two cases are briefly described. The interesting feature is that at the first examination the disease was localized to only one bone. Only later after extension of the disease to other parts of the skeleton could an accurate diagnosis be made.—*T. Leucutia.*

FAIRBANK, H. A. T. Congenital dislocation of the hip; with special reference to the anatomy. *Brit. J. Surg.*, Jan., 1930, 17, 380-416.

This paper is profusely illustrated with anatomical specimens and roentgenograms and is of special interest to the orthopedic surgeon. The author's summary is as follows:

"In this paper I have endeavoured to call attention to the chief points of interest and importance in the anatomy of congenital dislocation of the hip. In particular the changes in the bone behind the acetabulum, with the

occasional formation of a facet at this spot, the arrangement of the capsule and the importance of the ischio-capsular band which forms a sling over the neck of the femur, have been pointed out. The muscles which chiefly assist the capsule in slinging the pelvis on the femur are, I contend, the psoas in front and the obturators and their associates behind. Factors which may contribute towards the production of the characteristic gait, and the causation of the pain experienced in later life, are discussed. Finally, in a rapid survey of the treatment, the various operative procedures at our disposal have been criticized in the light of the foregoing facts and theories.

"In these days of Child Welfare Centres, better diagnosis, and the ever increasing practice of routine X-ray examinations, the number of cases of congenital dislocation left untreated till all hope of a cure is past is gradually diminishing. It cannot be insisted upon too strongly or too often that these cases must be sent to the surgeon early. Treated in early childhood the majority are cured by the manipulative method and of the rest an ever increasing number should be cured by open operation.

"Is it too much to hope that the time will come, and that before many years, when every uncomplicated congenital hip will be cured at an early age, and the difficult problem presented by the irreducible case, hopelessly crippled on reaching adult life, will cease to trouble the surgeon?"—*R. S. Bromer.*

PASCHETTA, VINCENT. Diagnostic de l'engrènement des fractures du col du fémur par la méthode des radiographies en trois positions. (Diagnosis of impaction of fractures of the neck of the femur by means of roentgenograms in three positions.) *Bull. et mém. Soc. de radiol. méd. de France*, Dec., 1929, 17, 319-325.

The author advises the taking of three roentgenograms for the diagnosis of impacted fractures of the femoral neck: one with the lower extremity straight, one in adduction and one in abduction. In impaction the relation of the head of the femur and of the shaft on the three roentgenograms remains the same, while in case of non-impaction the relation changes. The procedure can also be used with advantage for the estimation of the formation of callus and in pseudoarthrosis.



The method was applied in 20 instances, in 10 of which there was impaction and in 10 non-impaction of the fracture.—*T. Leucutia*.

RENANDER, AXEL. Anomalies roentgenologically observed of the cranio-vertebral region. *Acta radiol.*, 1929, 10, 502-513.

The author describes a case, examined roentgenologically, of posterior spina bifida of the atlas and an anomaly of the craniovertebral region; in the course of an anatomical preparation of the latter specimen it was found that there was a ligamentous connection between the left arch of the atlas and the occiput. The author assumes that, like spina bifida of the lumbosacral region, spina bifida of the atlas may cause spinal cord symptoms. In one case there was also a neurinoma of the auditory nerve; the author thinks this is an interesting analogy with the combination of lumbosacral spina bifida and Recklinghausen's disease.—*Audrey G. Morgan*.

RENANDER, AXEL. Entwicklungsstörungen der Wirbel. Somatoschisis. Hemispondylus. (Disturbances of development of the spinal column. Somatoschisis. Hemispondylus.) *Acta radiol.*, 1929, 10, 588-597.

Two cases are described, one in man of thirty-seven and the other in a boy of twelve. The anomalies in both cases were discovered on examination for other conditions. In the first, there was a fissure of the bodies of the affected vertebrae and in the other, only half of the vertebrae had developed. In the second case there was also a supernumerary vertebra with an accessory rib. The author classifies these anomalies according to Putti's scheme for disturbances of development of the spinal column, diagrammatic sketches of which are given. There is a disturbance which occurs in the membranous stage of development of the spinal column with an abnormal anlage of the center of ossification; in the second case the center was shifted to one-half of the metamere.—*Audrey G. Morgan*.

SMITH, S. WATSON. Kümmell's disease. *Brit. M. J.*, Jan. 18, 1930, 1, 109-110.

Kümmell described a condition of the spine best named a rarefying osteitis of a vertebral body following trauma. There occurs a vertical collapse of the body with posteroanterior wedging. Commonly the acute traumatic

symptoms subside rapidly, there follows a latent period of several months or years, and eventually symptoms referable to the consequent deformity appear. Diagnosis depends upon history, local pain and deformity and the roentgen appearances.

A case report is given of a woman of forty-seven, who developed symptoms eleven years after an injury to the cervical spine. The diagnosis of Kümmell's disease was made after careful study.—*G. R. Miller*.

ROEDERER, C., and CHARLIER. Un cas rare d'anomalie du sacrum. (A rare case of anomaly of the sacrum.) *Bull. et mém. Soc. de radiol. méd. de France*, Dec., 1929, 17, 290.

A dermoid cyst of the sacral region in a girl nineteen years of age led to a considerable shortening of the sacrum in the posteroanterior view and a rectangular deformity in the lateral view. The bone destruction produced by the cyst and the pull of the neighboring muscles on the lower end of the sacrum were responsible for the deformity.—*T. Leucutia*.

## ROENTGEN AND RADIUM THERAPY

STUMPKE, G. Über die Ergebnisse der Röntgentherapie beim Hautkrebs. (Results of roentgen treatment in skin cancer.) *Strahlentherapie*, Jan. 9, 1930, 35, 98-102.

The author reports the results of the skin cancers treated for about fifteen years. The figures are not absolute for in the beginning too small doses were used in some of the cases, some of the patients have not been found, etc. But taking these limitations into consideration, the material is divided into three groups, one of cancroids, one of deeper skin carcinomas and one of lupus carcinomas. In the first group there were 34 cases and 19 permanent cures, 3 recurrences, 1 death and 11 improvements. Among the 19 cured cases, 12 had only a single roentgen treatment, 9 had a full dose and three had 2/3 of a dose, filtered through 3-4 mm. aluminum. Of the other 7 cases 6 were given up to as much as 3 full doses in the course of several years. Of the 11 improved cases 3 were irradiated once, 5 twice, 2 three times and 1 four times; the doses varied from 2/3 of a dose to three full doses, generally distributed over quite a long time.

The results were similar in group 2: among a total of 17 cases there were 10 cures, 4 improvements, 3 recurrences and no deaths. As in the first group the majority of the cured patients were given only one irradiation of  $2/3$  of a dose to a full dose.

But in group 3, of 13 cases there were no permanent cures, but 10 improvements, 2 recurrences after apparent cure, and 1 death. These results show that roentgen irradiation is not very effective in lupus carcinoma and they also show the necessity of great care in the treatment of lupus vulgaris. Possibly radium would be a better treatment for lupus carcinoma.—*Audrey G. Morgan.*

FUHS, H., and KONRAD, J. Über Erfahrungen mit der indirekten Röntgenbestrahlung von Hautkrankheiten. (On experiences with indirect roentgen irradiation of skin diseases.) *Strahlentherapie*, 1930, 35, 239-249.

The authors have treated 157 cases of various dermatoses with indirect roentgen irradiations by using roentgen rays of 0.17 to 0.47 mm. half-value layer in copper and a dose of 100 to 200 R. The regions irradiated were as follows: thymus for psoriasis, scleroderma and vitiligo; pituitary gland for acne, alopecia, chronic eczema, lichen urticatus, psoriasis, pruritus and chronic urticaria; the sympathetic nervous system for chronic eczema, lichen ruber planus, Raynaud's disease, pemphigus vulgaris, pruritus, scleroderma; the spleen (in some instances including the liver) for acne, eczema, furunculosis, urticaria, strophulus, and the regional lymph glands for lupus erythematoses discoides.

The conclusion is reached that the indirect roentgen irradiation is practically valueless in the treatment of various dermatoses except some very few conditions which are on an endocrine basis. A case of diffuse alopecia occurring in a girl nineteen years of age which markedly improved following irradiation of the pituitary gland is described in detail and illustrated with photographs.—*T. Leucutia.*

GRÜTZ, O. Röntgenkastration bei Impetigo herpetiformis. (Roentgen castration in impetigo herpetiformis.) *Strahlentherapie*, 1930, 35, 501-512.

A case of impetigo herpetiformis is described in a woman thirty-five years of age. The pustular skin eruption first occurred in the second

month of the second pregnancy; it persisted through the entire pregnancy and puerperium, then it regressed only to recur with each subsequent menstruation. For this reason the author induced a temporary castration and the eruptions ceased.

The case is described because of its extreme rarity (the author was able to observe only 2 cases during a period of 10 years), and since roentgen castration led to apparent healing.—*T. Leucutia.*

ROHRBACH, R. Die Röntgenbehandlung der chronischen Paronychie. (Roentgen treatment of chronic paronychia.) *Strahlentherapie*, Jan. 9, 1930, 35, 136-138.

The chronic paronychias not caused by a specific microorganism are very stubborn and very troublesome to the patients and unlike specific infections of the nail-bed, are very common. Treatment with antiseptic fluids and salves has very little effect. Roentgen treatment has proved very effective. The author gives 12 x with a 2 mm. Al filter and this irradiation is repeated after six weeks; if there is recurrence it is repeated again after three to six months. The joint is covered carefully so that only the terminal phalanx is exposed to the rays. Generally not all of the fingers are affected, but only the fingers of one hand, or only both thumbs, both index fingers, etc. In such cases the author made comparative tests, using roentgen rays on one hand and the usual salve treatment on the other. The results of roentgen treatment were in all cases very much superior to those of other methods of treatment.—*Audrey G. Morgan.*

BECK, A. Zur Strahlenbehandlung von Knochenmetastasen nach Mammacarcinom. (Roentgen therapy of bone metastases in mammary carcinoma.) *Strahlentherapie*, 1930, 35, 513-517.

Three cases of bone metastases in mammary carcinoma which were successfully treated by irradiation are briefly described. In the first case the metastasis occurred to the seventh dorsal vertebra and the patient is now well for a period of over six years. In the second case the metastasis was to the pelvic bones and in the third case to the right upper femur (resulting in a pathological fracture). These latter two cases were treated only one year ago and thus

it is too soon to express an opinion with regard to their final outcome.

In conclusion, the author endorses the opinion of Borak and Kienböck that all carcinoma metastases to the bony structures should be treated systematically by radiation.—*T. Leucutia*.

FUHS, HERBERT. Zur Röntgen-Allgemeinbestrahlung mit kleinsten Strahlendosen bei Hautkrankheiten. (General roentgen irradiation with very small doses in skin diseases). *Strahlentherapie*, 1929, 34, 862-867.

The author used a focus-skin distance of 130 cm. with the central ray adjusted to the middle of the sagittal diameter of the body and irradiated front and back on alternate days. In a few cases the sides were also irradiated. Generally one to three series of irradiations were given. A series consisted of two irradiations each front and back. The second series followed the first immediately while there was an interval of a week between the second and third. About 15 R with moderately hard rays was given with 130 kv., filtered through 4 mm. Al.

Forty-four cases were treated, including cases of furunculosis, eczema, lichen ruber planus, mycosis fungoides in the premycotic stage, pityriasis, prurigo, psoriasis vulgaris, salvarsan dermatitis and chronic recurrent urticaria. Thirty-two of the cases, or about 75 per cent, were cured or greatly improved; 11 or 1/3 of these were completely cured. In the majority of cases two series of irradiations were enough. Among the cases that were not so favorably affected were ones of stubborn desquamating eczema, lichen ruber planus, lymphogranulomatous prurigo, chronic recurrent urticaria, 2 cases of pityriasis lichenoides chronica, 2 cases of mycosis fungoides that had already been given roentgen treatment and 4 cases of stubborn psoriasis vulgaris which had resisted all the usual methods of treatment. As the method has no bad by-effects it may be used in combination with non-irritant medical treatment to shorten the course of certain skin diseases.—*Audrey G. Morgan*.

V. JASCHKE, R. T. Das Kernproblem im Kampfe gegen das Uteruscarcinom. (The chief point in the struggle against cancer of the uterus.) *Strahlentherapie*, Jan. 9, 1930, 35, 47-53.

There is a great deal of discussion as to whether operation or irradiation is the best treatment for carcinoma of the uterus, but the chief point is to treat the patient at a period when either is hopeful. It is certain that either operation or irradiation gives the best results if the carcinoma is still limited to the uterus. At present there is not more than 20-25 per cent permanent cure in cancer of the cervix but if the patients could be treated before the glands are involved there should be 75-80 per cent permanent cures. Statistics are given showing the time at which the patients first present themselves for treatment after the symptoms begin and the time that passes from the first time they come to the physician before they are sent for operation. The figures show that in about one-fourth to one-fifth of carcinoma cases the patients themselves do not come to the physician until it is too late, but in another fifth the delay is almost certainly the fault of the physician and in another fifth probably so.

Two things are necessary in order to overcome this unfortunate condition of affairs: first, instruction of the public and second, of physicians. The physician should be made to feel his great responsibility in the matter and that it is commendable for him to send a patient for surgical examination if there is the least suspicion of carcinoma, even if the examination does not confirm it. The question should be kept constantly alive in the medical journals. Popular lectures do not seem to have accomplished much in the way of instructing the public, but they have generally been given in university towns where they are least needed. Pictures and other material from museums of hygiene and public health should be sent out to the smaller towns and the physician should take it upon himself to instruct his own public in one way or another, either in his daily work with families, by means of lectures or little articles in the local newspapers; but in one way or another women should be made to feel the importance of coming for examination for any irregularity in menstruation in the cancer years.—*Audrey G. Morgan*.

RITTER, H., and KARRENBURG, C. L. Thallium-epilation oder Röntgenenthaarung? (Should thallium or roentgen rays be used for epilation?) *Strahlentherapie*, Jan. 9, 1930, 35, 116-122.

The authors believe that roentgen epilation

is unconditionally to be preferred to thallium. With increasing use of thallium severe injuries and even deaths have been reported in increasing numbers. Serious psychic disturbances, epileptic attacks, neuritis, myasthenia, adynamia and motor disturbances have been reported, in addition to the milder symptoms of vomiting, dizziness, pain in the joints, etc. More or less serious symptoms have been reported in from 8 to 58 per cent of the cases by various authors. The effective and toxic doses of thallium lie very close together so it is hard to use it without bad effects. In addition to the danger in the use of the drug it is not very effective. So on the ground of both effectiveness and lack of danger roentgen epilation is greatly to be preferred.—*Audrey G. Morgan.*

HABERMANN, R. Röntgenschädigung nach Epilation eines Kindeskopfes mit Schwermetallfilterung und ihre forensische Beurteilung. (Roentgen injury after epilation in a child with heavy metal filtration, and medicolegal judgment on it.) *Strahlentherapie*, Jan. 9, 1930, 35, 123-129.

A child three years of age was irradiated for a mycosis or eczema first from a single field, and then four weeks later it was given a total epilation irradiation from seven fields. Three weeks after the irradiation there was a reaction of the third degree that was at first interpreted as erysipelas with ulceration; it did not heal until more than a year later with almost total cicatrization of the scalp. Its late appearance was evidently because of the excessive hardness of the rays used and the cross-firing; at first 20 per cent of a skin erythema dose was used over a single field and then 33 per cent of a skin erythema dose over 7 fields, with 0.5 mm. zinc filter.

The first expert who passed an opinion said it was the fault of the roentgenologist but the second legal opinion passed on it was that the erythema may have caused itching and scratching through which infection and erysipelas occurred, and that as this took place at the height of the roentgen reaction, the summation of the two injuries had serious results. At any rate, when irradiation is being given for dermatological conditions a dermatologist should be present unless the roentgenologist himself is a trained dermatologist.—*Audrey G. Morgan.*

SCHOENHOLZ, L., and HIRSCH, H. Histochemische Untersuchungen am Carcinoma vor und nach der Bestrahlung. (Histochemical examinations of carcinoma before and after irradiation.) *Strahlentherapie*, 1929, 34, 273-287.

The authors studied mineral metabolism in carcinoma tissue by reducing thin sections to ash after roentgen and radium irradiations and determining the calcium content of the ash. One case is described in which radium was used and another in which roentgen irradiation was used. Two days after irradiation there was a great increase in the amount of calcium in the cancer cells at a time when no effect of the irradiation can be seen with ordinary histological examination. The authors believe from their pictures that this increase in calcium is a result of the irradiation and is not dependent on any change in the connective tissue stroma. The increased amount of calcium taken up by the cancer cells after irradiation they think is an evidence that the primary point of action of the rays is the cancer cell; this is also indicated by vacuolization and clumping of chromatin. There is no evidence that these changes are a result of action of the rays on the connective tissue particularly as the connective tissue also shows an increase in calcium after irradiation.—*Audrey G. Morgan.*

BRANDT, W. Zur Behandlung des Lupus vulgaris. (Treatment of lupus vulgaris.) *Strahlentherapie*, Jan. 9, 1930, 35, 149-157.

Among 349 cases of lupus that were re-examined later 34.4 per cent were completely cured, 12.9 per cent greatly improved but not entirely cured, 52.7 per cent uninfluenced. The quartz lamp is the best method of local treatment. Roentgen treatment is dangerous and not very apt to bring about permanent cure, so it should be limited to only a few treatments and low doses in a few cases. It is impossible to say at present just how large a dose can be allowed. The older the lupus, the harder it is to cure. In 39.8 per cent of the cases the lupus developed before ten years of age, in almost 70 per cent before twenty. Among 288 lupus patients only 1.73 per cent had had pulmonary tuberculosis according to their statements. In 34.8 per cent there was tuberculosis in the family. In the examination of 106 patients who had died of lupus it was found that about 40



per cent had had an active tuberculosis not localized on the skin. Among 86 lupus patients 40.69 per cent died of tuberculosis.—*Audrey G. Morgan.*

JOSEPH, EUGEN. The treatment of malignant tumors with radium catgut. *Lancet*, Jan. 4, 1930, *I*, 21-22.

The author believes that the best result with radium when used on malignant tumors is obtained by an even distribution throughout the extent of the tumor for the longest possible time. The retention of the radium is dangerous and it has been shown that the largest quantity which a man weighing 70 kg. can tolerate without grave danger is less than half a milligram. This, plus the expense is perhaps why this method has not been adopted.

The use of radium silk, or better, radium catgut, in sewing up the abdominal wall after the removal of a tumor would perhaps prevent recurrence in the wound and would reduce the incidence of stitch infections. The radium should be so distributed over the gut that the dose in the length to be used shall not exceed half a milligram. Treatment with radium catgut can be carried out in the above-mentioned manner in sewing abdominal wounds as an inoperable tumor may be threaded across and across with lengths of radium catgut.—*G. R. Miller.*

HALBERSTAEDTER, L., and SEIFFERT, A. Zur Strahlenbehandlung des Kehlkopfcarcinoms. (Radiation treatment of laryngeal carcinoma.) *Strahlentherapie*, 1930, *35*, 518-522.

During the past few years the authors have treated 20 cases of carcinoma of the larynx by using a modification of the technique of Finzi and Harmer. As is known these authors introduce the radium through a laryngo-fissure and place it in actual contact with the tumor for a period of four and a half to eight days.

The present authors make use of the same route. However, instead of applying the radium in the form of needles as is done by Finzi and Harmer they have constructed an applicator which is 2 cm. long and 1.5 cm. wide and which contains 10 to 15 mg. radium element filtered by 1 mm. platinum. The posterior aspect of the applicator is filtered by 1 mm. lead so as to protect the laryngeal tissues. The applicator is placed in direct contact with the tumor and the wound is closed aseptically

(without performing tracheotomy which according to the authors is unnecessary). Eight days later the wound is reopened and the applicator removed. In case that the lesion extends to both sides of the larynx two applicators are introduced, one on each side. However in this instance the radium is placed between the perichondrium and the laryngeal cartilage (without laryngo-fissure) and is left in situ for a period of only four to five days.

The immediate results were very satisfactory but it is too soon to draw conclusions as to the final results.—*T. Leucutia.*

GASK, G. E. Treatment of epithelioma of the tongue by radium. *Lancet*, Feb. 1, 1930, *I*, 223-227.

The results of the various surgical procedures used in the treatment of cancer of the tongue compiled at St. Bartholomew's Hospital in London, showed a five year cure of 17.1 per cent. Other Island and Continental clinics gave statistics which varied between 14.3 per cent to as high as 30.8 per cent for three year periods. Continental clinic figures for radium alone report 45 per cent of five year cures as regards the primary site and 20 per cent of absolute five year cures.

In St. Bartholomew's Hospital the primary tongue growth has been treated by radon seeds of strength varying from 1.5 to 3 mc., and the glands in the neck by radium needles inserted by puncture. The primary lesion disappeared in the majority of instances except in those cases where biopsy showed the lesion to be histologically Grade 1.

The treatment of the lymphatic glands presented the main difficulty. The method of irradiating them with needles did not always prove satisfactory. The Westminster Hospital secured their best results by dissection of the glands followed by irradiation. This was also the method of choice at the Radium Institute of Paris.

With these results in view, the procedure in the future will be block dissection whenever possible, to be followed by irradiation.—*G. R. Miller.*

CARLING, FRANCIS ROCK. Radium teletherapy. *Brit. M. J.*, Feb. 8, 1930, *I*, 232-234.

An apparatus designed at the Westminster Hospital in London to meet the problem of the most effective and economical use of the 4

grams of radium available consists of a bomb which holds twenty containers arranged in groups of five. Each group can be withdrawn from use by pulling the appropriate knob outside the bomb.

By use of high and low stretchers two patients may be treated at the same time, the bomb being placed between the stretchers on a suitable apparatus.—*G. R. Miller.*

JACOBS, J. Zur Behandlung der Lymphogranulomatose. (Irradiation of lymphogranulomatosis.) *Strahlentherapie*, 1930, 35, 533-538.

Thirty cases of lymphogranulomatosis have been treated by the author during the past five years by repeated irradiation of the involved lymph nodes with doses of from 30 to 50 per cent s. u. d. (0.5 mm. Cu and 190 kv.). For the past two years the roentgen irradiation has been combined with the administration of dextrocid (10 c.c. of a 30 to 50 per cent solution). One case which has remained well now for a period of two years is described briefly in order to illustrate the method of procedure.—*T. Leucutia.*

KONRAD, JOSEF. Behandlungserfolge mit Buckys Grenzstrahlen in der Dermatologie. (Treatment results with Bucky borderline rays in dermatology.) *Strahlentherapie*, 1930, 35, 567-580.

Four hundred cases of various dermatological conditions were treated by the author with borderline rays (10 kv., 10 ma., and 10 cm. skin target distance, or in more generalized cases, 15 cm. skin target distance). Three different tubes were used for this purpose and it is interesting to note the great variation which existed in the emission of the rays (due to the different window thicknesses) of these tubes. The ratio was as follows: first tube, 40 R; second tube, 150 R; third tube, 81 R. It was also found that the emission changed with use, due to the destruction of the celluloid coat of the Lindemann window.

The borderline rays were of especial value in the treatment of alopecia areata, and of skin conditions of the hairy scalp, in verrucae planae juveniles, in verrucae vulgares of the hands, in clavi plantares, in eczemas of the eyelids, in certain tuberculous lesions (tuberculosis verru-

cosa cutis and erythema induratum Bazin), in pemphigus benignus, lichen ruber accuminatus and naevus flammeus.

In seborrhea, acne, various eczemas, staphylococcic infections of the skin and skin carcinomas roentgen rays were of greater benefit.

More recently the author has used the borderline rays in gonorrheic epididymitis (up to a dose of 100 R) with remarkable analgesic effect.—*T. Leucutia.*

BORAK, J. The analgesic effects of roentgen rays with especial consideration of bone metastasis of cancer. *Radiology*, April, 1930, 14, 328-338.

In the opinion of the author the fundamental differences in the analgesic effect of roentgen rays and pure analgesics lies in the fact that the roentgen rays can influence solely a pain that has arisen under pathologic conditions. In other words, the roentgen rays act as an analgesic only when they act therapeutically and only to the extent that they exert healing effects. The bone metastases of cancer are of comparatively slight virulence and the most sensitive of all carcinomas to the roentgen ray. They do not produce pain until the periosteum or nerve trunks adjacent to the bone become involved. By roentgen therapy growth of the bone metastasis is not merely checked, but caused to retrogress or disappear. When the dose is properly adjusted, roentgen therapy thus has a lasting effect on the pain, suppressing it for at least several years. Borak cites cases of bone metastasis in which pain was suppressed and at necropsy the metastasis, which previously was demonstrable roentgenographically, had completely disappeared.—*J. D. Camp.*

TOWNE, EDWARD B. Treatment of pituitary tumors; the role of the röntgen-ray and of surgery therein. *Ann. Surg.*, Jan., 1930, 91, 29-36.

Towne states that few neurosurgeons believe in the efficacy of the roentgen ray in the treatment of adenomas of the pituitary gland. Some have given it a brief trial before operation, and many use it after operation. In 1926 Towne reported 2 cases of pituitary tumor in which the visual fields and visual acuity had been restored to approximately normal for

periods of three and two years respectively by roentgen treatment. These cases and a review of the literature led to the following deductions: (1) Cushing's statistics showed that 20 per cent of pituitary adenomas were cystic, and that about 20 per cent of his patients conserved useful vision for more than five years after operation. The remaining 80 per cent either did not regain useful vision, or had recurrences after a period of about two years. These figures suggested that the results of surgery were lasting only when a cystic tumor was encountered. (2) Towne's cases and others in the literature showed excellent results for periods of from two to thirteen years after roentgen treatment. It must be assumed, Towne states, that these were solid tumors, as cysts would not respond to roentgen therapy, and therefore there was reason to believe that 4 out of 5 pituitary adenomas could be treated more safely and with more lasting results by roentgen radiation than by surgery.

Towne's present paper deals with the subsequent history of the 2 patients who were the basis of his first report and also with the records of 3 others who have been under observation for more than two and a half years.

Case 1. Restoration of normal visual acuity and fields for five years by roentgen treatment. Recurrence, failure of roentgen therapy, temporary improvement following operation, and death seventeen months after recurrence.

Case 2. Restoration of normal visual acuity and fields by roentgen treatment. Recurrence after two years, eight months; failure of roentgen treatment. Prompt improvement after evacuation of cyst, lasting to date, three years after operation.

Case 3. Bitemporal hemianopsia not improved by roentgen treatment; condition stationary three and one-third years later; operation refused.

Case 4. Blindness for three months. Slight response to roentgen radiation; no response to surgery.

Case 5. Bitemporal hemianopsia with loss of central vision in left eye, cured by roentgen radiation. Normal visual acuity and fields two years, ten months later.

Most of the roentgen treatments in these cases were given by Dr. W. E. Chamberlain and Dr. R. R. Newell at Stanford University Hospital. The usual treatment is exemplified

by that given in Case 5, which Dr. Newell summarized as follows: "200 R filtered x-ray ( $\lambda$  effective equals 1.17 Ångströms) to each of 5 areas, each temple, forehead, vertex and occiput, given every month. These were divided among three days on each monthly series. The areas were 9×9 cm. and the tube distance 31 cm."

Numerous scattered reports of pituitary adenomas are appearing in the literature which have been favorably influenced by roentgen therapy. It will be unfortunate if the cases are not selected carefully by physicians trying this method of treatment. Only adenomas of the anterior lobe, which enlarge and destroy the sella, are amenable to roentgen therapy. Other tumors in the region of the chiasm may give the characteristic picture in the visual fields, but not the changes in the sella and none of these will respond to roentgen radiation. There should be cooperation between the ophthalmologist, roentgenologist and the neurosurgeon in the treatment of pituitary adenomas. R

*Conclusions.* 1. Eighty per cent of pituitary adenomas are solid, and 20 per cent are cystic.

2. Twenty per cent of patients retain useful vision for more than five years after operation; 80 per cent show no improvement or, after more or less marked improvement, have recurrences after about two years.

3. Operative treatment of pituitary adenomas has a mortality ranging from 7 per cent upward; roentgen treatment has no mortality.

4. Cases are reported which illustrate long-standing favorable results from roentgen treatment, and show that if the result is not good, a cystic tumor favorable for surgery maybe diagnosed.

5. The present custom of following surgery immediately with roentgen treatment confuses the issue. The two methods may be used separately without jeopardizing the patient's chance for a cure.

6. It is proposed that all pituitary adenomas be treated by roentgen radiation under the observation of the ophthalmologist and the neurosurgeon, that the treatment be stopped as soon as improvement begins, and that surgery be undertaken short of six months only when visual acuity and fields recede under roentgen treatment.—R. S. Bromer.

MOGILNITZKY, B. N., and PODLJASCHUK, L. D. Zur Frage über die Wirkung der Röntgenstrahlen auf das zentrale Nervensystem. (The effect of roentgen rays on the central nervous system.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*. Dec., 1929, 40, 1096-1108.

The authors investigated the effect of the roentgen rays on the central nervous system in 40 animals (16 dogs and 24 rabbits). The skull was irradiated either in its entirety or through individual fields (frontal, parietal, temporal and oblongata region), animals of identical age, size and weight being used as controls. The irradiation was carried out with doses of from  $\frac{3}{4}$  to  $10\frac{1}{2}$  S.U.D. per field, with 120 to 180 kv., 3 mm. Al. or 0.5 mm. Zn and 1.0 mm. Al.

According to the length of the time of observation following the irradiation, the animals were divided into two groups: (1) those observed from one to six months, and (2) those observed from one to sixteen days.

It was found that in adult animals large doses of roentgen rays produced no changes whatever on the ganglion cells of the brain. There was, however, some cellular reaction of the mesenchyme apparatus, consisting in proliferative processes and alterations of the permeability of the blood vessels.

In young animals, the roentgen rays led to degenerative atrophic changes of both the mesenchyme apparatus and the ganglion cells of the cortex, this signifying that age and constitution are important criteria in the irradiation of the brain.

It was also found that in adult animals the irradiation with fractional doses led to a breaking down of the "hemato-encephalic barrier". The meaning of this will be discussed in a future article.—*T. Leucutia*.

MOGILNITZKY, B., and PODLJASCHUK, L. Röntgenstrahlen und sogen. "hamato-enzephalische Barriere". (Roentgen rays and the so-called "hemato-encephalic barrier".) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1930, 41, 66-75.

In the course of roentgen irradiation of the brain it was observed that in certain instances a functional disturbance of the mesenchyme apparatus developed, leading to a breaking down of the hemato-encephalic barrier.

As is known, the hemato-encephalic bar-

rier (Stern) consists in a sort of protection of the central nervous system against toxins and poisonous substances circulating in the blood. It is yet undetermined which of the tissues is specifically connected with this peculiar function of the mesenchyme apparatus.

The authors performed a number of experiments (in rabbits and dogs) in order to determine the exact effect of various doses of roentgen rays (150 kv., 3 mm. Al.) on the hemato-encephalic barrier. A 1 to 2 per cent solution of trypan-blue and in some instances a 2 per cent solution of saccharated ferrous oxide were used intravenously for testing the intactness of the barrier. Under normal conditions, neither of these substances passes from the blood into the brain tissues proper, but as soon as the brain is irradiated (with fractional doses) both the trypan-blue and saccharated ferrous oxide may appear in certain tissues of the brain.

From the point of view of the dose applied, the experiments were divided into four groups: (1) massive radiation in one sitting with doses from  $3\frac{1}{2}$  to  $10\frac{1}{2}$  S.U.D. (10 rabbits).

The trypan-blue (and in some instances the saccharated ferrous oxide) was injected preliminary to or at different intervals following the irradiation. In none of the instances was there any effect on the hemato-encephalic barrier. (2) Fractional irradiation with doses of from 2 to 5 S.U.D. (8 rabbits and 2 dogs). Here trypan-blue and saccharated ferrous oxide were injected at different intervals following the administration of fractions of radiation. It was found that in addition to the already described morphologic changes of the mesenchyme apparatus (see above abstract) there were also physico-chemical changes resulting in a breaking down of the hemato-encephalic barrier. Both the trypan-blue and the saccharated ferrous oxide lodged (adsorbed) in the endothelium and the perivascular glia elements, indicating that a change in the permeability of the vascular system resulted. (3) In a third series of experiments (15 rabbits) it was attempted to determine the beginning and the actual duration of the adsorption phenomena and it was found that both the trypan-blue and saccharated ferrous oxide disappeared within three days following the injection. A repetition of the fractional irradiation within twenty days reestablished the adsorption phe-



nomena but further repetition of the irradiation remained without influence on the hemato-encephalic barrier. (4) Mild irradiation with doses of from 3 to 2 H (4 rabbits). In these experiments a mild adsorption phenomenon was observed, however without any morphologic changes.

The conclusion is reached that roentgen irradiation of the brain tissues with fractional doses leads to a breaking down of the hemato-encephalic barrier, due chiefly to changes in the permeability of the vascular system of the mesoglia.—*T. Leucutia*.

GABRIEL, G. Über die Beeinflussung des vegetativen Systems durch die Röntgenstrahlen. (Effect of roentgen rays on the vegetative nervous system.) *Strahlentherapie*, 1929, 34, 813-822.

The vagus and sympathetic were irradiated on the right side of the neck in rabbits and electrocardiograms made to determine the effects. The protocols of the experiments are given and electrocardiograms reproduced. The electrocardiograms show a disturbance of balance of the vegetative system and an increase of vagus tonus. When the heart alone was irradiated with large doses the electrocardiograms showed that its function was disturbed. The T and P peaks were distinctly smaller than in non-irradiated animals and there was disturbance of heart rhythm, but this was not constant. Unlike the changes caused by irradiation of the vegetative system these changes did not disappear completely when the irradiation was stopped. No severe chronic injuries were seen for the time the observations were continued. It was impossible to tell from the electrocardiograms whether the point of action of the rays was the myocardium or the nervous system.—*Audrey S. Morgan*.

PFÄHLER, GEORGE E., and PARRY, LEO D. Results of roentgen therapy in carcinoma of the breast. *J. Am. M. Ass.*, Jan. 11, 1930, 94, 101-105.

Nine hundred and thirty-nine private cases of breast cancer treated between June, 1920 and June, 1926 are reviewed.

The end-results are affected by the type of cancer, age of patient, stage and rapidity of growth, extent of metastasis, regions invaded, physical resistance of the patient, duration of

symptoms before operation and irradiation, and the duration of the recurrence.

The ages varied from sixteen to eighty-five years, 64.4 per cent being between thirty and fifty-five years; 1.3 per cent were males. In 90 per cent of cases a lump, pain or an injury was the first sign. The average duration of symptoms before application for any kind of treatment was nineteen months, and the average time between operation and irradiation was fifteen months.

Grading of the degree of malignancy by microscopic examination was not found to be of value in prognosis.

Preoperative plus postoperative irradiation preferably beginning two weeks after operation is advised. In cases without glandular involvement so treated there were 66 per cent of five year cures. In advanced cases with glandular involvement there were five year cures in 46 per cent, while 38 per cent of totally inoperable cases were made operable by preoperative irradiation and 10 per cent of these were alive after five years.

Postoperative treatment alone in cases without preoperative glandular involvement gave 89 per cent of five year cures. Cases with preoperative glandular involvement showed 47 per cent of five year cures. Review of statistics recorded in the literature shows 77 per cent of five year cures by surgery alone in cases without glandular involvement, and 74 per cent of five year cures in such cases when treated with both surgery and postoperative irradiation. In the literature cases with glandular involvement show 20 per cent of five year cures by surgery alone, and 35 per cent when postoperative irradiation is added.—*G. R. Miller*.

VON AMMON, ERNST. Die Erfolge der Strahlenbehandlung bei Uterusmyomen und hämorrhagischen Metropathien. (Results of radiotherapy in myomas of the uterus and hemorrhagic metropathies.) *Strahlentherapie*, 1929, 34, 457-500.

Fifteen thousand cases are reviewed from the literature with tables showing the details of the results. Cure was brought about in 96 per cent of cases of myomas and hemorrhagic metropathies by radiotherapy. There were 3.9 per cent failures and a mortality of only 0.1 per cent, results rarely attained in any field

of medicine. Operative treatment can never show such results, for even with all improvements in operative technique and after-treatment, the danger of operation can never be entirely overcome. The success of radiotherapy is also indicated by the fact that it is being used more and more all the time; from the beginning of radiotherapy in 1908 up to 1921, 11,056 cases were treated, and from 1922 and 1927, 15,937 cases. In 1920 and 1921 there was a slight increase in the percentage of cures, which then fell to the former figure, due to extension of the indications and resultant inclusion of cases that were harder to cure. Careful diagnosis and indications and accurate dosage, and for radium the strictest asepsis, will improve the results still further.—*Audrey G. Morgan.*

FÜRST, WALTER. Untersuchungen über die Dosierung harter Röntgenstrahlung aus Fernfeldern bei der Behandlung des Collumcarcinomas. (Dosage of hard roentgen rays from distant fields in the treatment of carcinoma of the cervix.) *Strahlentherapie*, 1929, 34, 340-380.

Twelve cases are described in which carcinoma of the cervix was treated with double tubes, and a detailed discussion is given of the effects of double tube irradiation as compared with that of single tubes. The author concludes that on irradiating from distant fields with two tubes at the same time the maximum dose for the skin is not the same as the maximum dose for the deeper tissue layers and therefore for carcinoma of the cervix. The maximum dose for the deep tissue layers and for the body in general is lower than that for the skin, in some cases considerably lower. So skin erythema cannot be used as a measure of dosage, at least for a high dosage of rays given within a short time. If biological supplementary doses are necessary the amount required depends not only on the focus-skin distance but also on the charge of the tube. A blood examination should be made before every irradiation in order to get evidence as to whether and when further irradiation or operation is necessary.—*Audrey G. Morgan.*

FÜRST, WALTER. Untersuchungen über die Dosierung harter Röntgenstrahlung aus Fernfeldern bei der Behandlung des Collumcarcinomas. (Dosage of hard roentgen rays

from distant fields in the treatment of carcinoma of the cervix.) *Strahlentherapie*, 1929, 34, 501-540.

For the author's investigations of the dosage of hard roentgen rays from distant fields in the treatment of carcinoma of the cervix it was necessary to establish biological standard values for single and double tube apparatus and for near and distant fields. These standard values had to be determined empirically and not from any theoretical calculations, and then fixed by technical methods of measurement.

In the course of his work he found that skin erythema is of very secondary importance in distant irradiation with hard rays. There may be danger of injury to deep tissues before there is any very considerable degree of skin erythema. Such injuries may appear in the form of infiltrations of the pelvic connective tissue and are not necessarily limited to the symptoms that occur after over-dosage applied to the bladder and intestine. It is particularly important to follow up the blood picture in judging the general resistance of the body.

The measurements differ somewhat depending on the patient's form. So the maximum doses given are based on primary irradiation and superficial and deep intensity on the phantom, though measurements can be taken on the surface of the patient's body and in the vagina with chambers independent of wave length.

If the irradiation is given in as short a time as possible the maximum doses for hard roentgen rays from distant fields in the treatment of carcinoma of the cervix are as follows:

For 2 ma. tubes, double tube arrangement, 60 cm. from the focus to the skin, the maximum dose of primary irradiation is 1430 R, measured on one of the double tubes with fields of 18×24 cm. and 9×24 cm.; the surface intensity is 2207 R measured for fields 18×24 cm. and 9×24cm.; the deep intensity is 1863 R measured for fields of the same size.

For 4 ma. tubes, double tube arrangement, 60 cm. distance from the focus to the skin, the maximum dose is: primary radiation 1588 R, measured on one of the double tubes for fields of the same size as above; surface intensity 2352 R, with fields of the same size; deep intensity 2128 R with fields the same size.

For 4 ma. tubes, double tube arrangement,

100 cm. focus-skin distance the maximum dose is: primary irradiation 1068-1228 R measured on one of the double tubes with a field 18×20 cm.; surface intensity 1556-1696 R, with a field of the same size; deep intensity 1524-1664 R with a field of the same size.—*Audrey G. Morgan.*

BOWING, HARRY H., and FRICKE, ROBERT E. Results obtained in the treatment of carcinoma of the cervix uteri with radium and x-rays. *Radiology*, March, 1930, 14, 211-216.

The authors reviewed 1094 patients treated during the decade from 1915 to 1924 inclusive, of whom 1001 were traced, and found that in the small operable group, operated on and subsequently treated by irradiation, 75 per cent survived five years. Of the borderline cases, 61.52 per cent of the patients were living after five years, and in a group previously treated elsewhere there were 24.82 per cent five year survivals.—*J. D. Camp.*

ST. SIMON. Zur intrauterinen Radiumanwendung. (Intrauterine use of radium.) *Strahlentherapie*, 1929, 34, 859-861.

The author criticizes the usual radium carriers used for intrauterine treatment and describes and illustrates one of his own. It is a nicked brass casing curved like a Hegar dilator; it has many holes in it so that the secretion can flow out. The normal length is 7 cm. though longer or shorter ones can be made for different lengths of the uterine canal. The length of the filter is calculated for the Dominici tubes 3.7 cm. in length that are generally used as a source of radiation. A supplementary filter of greater length with a closing piece can be used when two shorter carriers are to be used to irradiate both cervix and body. The thickness of the wall of the carrier combined with that of the radium capsule amounts to 1.5 mm. brass. The size of the carrier is that of a Hegar dilator No. 8 or 10. At the vaginal end there is a disk adapted to the convexity of the portio in contact with the two handles of the terminal piece. The object of this piece is to hold the radium firm and keep the gauze tampon at a distance from the disk so that the discharge of secretion will not be interfered with. The carrier can be taken apart and boiled. It is put in with a dressing forceps.

A certain amount of soft secondary irradiation

from the carrier is desirable in malignant disease and also where the uterine mucous membrane is to be cauterized, as for example in hemostasis.—*Audrey G. Morgan.*

BINKLEY, GEORGE E. Advantages and limitations of radiation in the treatment of rectal cancer. *Radiology*, March, 1930, 14, 207-210.

External irradiation, in the opinion of the author, constitutes the first step in radiation therapy of all rectal cancer, and in certain cases may be the only form of treatment necessary. The effect is limited by the depth of the tumor, the tolerance of the skin, and the radioresistance of the cancer. External radium irradiation is more effectual than high voltage roentgen rays. The two types of radiation may be combined advantageously.—*J. D. Camp.*

BOWING, H. H., FRICKE, R. E., and SMITH, N. D. Treatment of malignant tumors of the rectum by radium and roentgen rays. *Radiology*, Nov., 1929, 13, 443-450.

The authors report the results in 127 cases of malignant disease of the rectum treated at The Mayo Clinic with radium and roentgen rays. The majority of the cases were inoperable due to the size and extent of the primary lesion, or local metastasis, metastasis to important viscera or the patient's poor general condition. Adenocarcinoma of moderate malignancy predominated. Twenty-three per cent of the patients lived from three to six months, 18 per cent from six to nine months, and 34 per cent longer than nine months. Almost 4 per cent survived eighteen to twenty-four months, and slightly less than 3 per cent lived twenty-four months or more. The writers regard it as evident that the lives of these patients were prolonged and that the activity of the disease was reduced thus diminishing distressing complications. Improvement noted consisted largely in lessening of rectal discharge and pain, reduction of the size of the tumor and cessation of bleeding.—*J. D. Camp.*

HIRSCHBERG, M. Dauerheilung eines Tibiasarkoms mit Röntgenstrahlen und atrophische Vorgänge in der Bestrahlten Muskulatur. Spätrophie in der Halsmuskulatur nach einer einmaligen, vor 15 Jahren ausge-

fürhten Oberflächenröntgenbestrahlung. (Permanent cure of a sarcoma of the tibia with roentgen rays and atrophy of the irradiated muscles. Late atrophy of the muscles of the neck after superficial roentgen irradiation fifteen years before.) *Strahlentherapie*, 1929, 34, 421-424.

The first patient was a girl then nine years of age on whom roentgen treatment for a sarcoma of the tibia was begun on Dec. 20, 1918. Apex apparatus, AEG electron tube, 38 cm. spark gap, 2 ma., zinc-aluminum filter. The tibia was irradiated from inside, outside and behind, 20 minutes per field; three series at intervals of 8 days. In April, 1919, the three series were repeated. About two weeks after the last irradiation there was intense erythema with cyanosis, swelling and pain over the tumor. In May, 1919, the signs of reaction had disappeared and the tumor was smaller. In July, another series of irradiations was given. In December, the tumor had disappeared; the skin over the anterior surface of the tibia was pigmented. Now ten years after the irradiation there is no sign of tumor but the muscles of the calf are greatly atrophied. The patient first noticed the atrophy in March, 1923, shortly after menstruation began. The author questions whether this was the effect of irradiating a child's muscles which remained latent for a long time and only became manifest at the time of puberty. Such a late injury from roentgen irradiation seems to be shown in another case that he treated. A boy of eight was sent to him in 1912 for trichophytosis. He irradiated five fields without a filter with 2 ma. and 16-18 cm. spark gap. The Sabouraud-Noiré dose was kept a little below the full dose. The hair fell out in two weeks and grew again afterward. At one place on the nape of the neck the hair remained scanty and telangiectases later developed at the border of the hair. The author did not see the patient again until 1928 when he was sent to him by a neurologist and a surgeon for examination of the cervical spinal column. The muscles of the nape of the neck and the upper border of the back muscles had atrophied greatly within the past year. The neurologist could not find any cause for it. The area of muscle atrophy coincided with the irradiated area. The author thinks this muscle atrophy too was caused by the superficial irra-

diation fifteen years before.—*Audrey G. Morgan*.

### MISCELLANEOUS

NEMENOW, M. I. Das Staatsinstitut für Röntgenologie, Radiologie und Krebsforschung in Leningrad. (The State Institute for Roentgenology, Radiology and Cancer Research in Leningrad.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Dec., 1929, 40, 1069-1087.

The Institute which is only twelve years old has the following divisions: (1) physical division, for standardization of measuring instruments, preparation of radon apparatus, and fluid air, and for various scientific investigations; (2) a clinical division (120 beds) which consists of a medical, surgical, gynecological and radiotherapeutic department; (3) radiobiologic division; (4) institute for cancer research comprehending biochemical, pathological, bacteriological, serological, botanic-microbiologic, and experimental histological and biological laboratories; (5) amphitheatres, museums, workshops, etc.

The Institute is under the actual direction of a roentgenologist (Nemenow) and has a staff of several professors, assistant professors, aspirants and interns, making a total of 75.

During each year two four month courses are given to practicing physicians from every part of the republic. The Institute publishes the *Annales de Roentgenologie et Radiologie* which lately has become the central organ of Russian roentgenologists and radium therapists.

A total of 150 scientific articles have been published since the foundation of the Institute. The titles of the most important articles are included.—*T. Leucuttia*.

HERZ, RICHARD. Über die Nachprüfung der Belichtungszeiten an Diagnostikapparaten. (A check-up of the time of exposure in diagnostic apparatus.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Nov., 1929, 40, 840-842.

The author describes a simple method for the check-up of the time of exposure of various roentgen apparatus. A gramophone in which the roentgen film serves as the record is used and a lead plate with six small holes arranged radially at definite distances is mounted above the film. For the actual determination of the



time of exposure the gramophone is set in motion (thus rotating the film underneath the lead plate) and the exposure is made through the individual holes (the other holes being covered by lead) for successive apparatus. After the film is developed the actual length of the ring-shaped exposure lines is measured and the time of exposure checked. With extremely short exposures (from  $1/100$  to  $3/100$  sec.) the error is less than 2 to 3 per cent.—*T. Leucutia*.

DIOLÈS. L'examen des stéréogrammes à l'aide des jumelles. (The reading of stereograms with the aid of binoculars.) *J. de radiol. et d'électrol.*, Jan., 1930, 14, 54-56.

The author has constructed binoculars both for the orthoscopic and pseudoscopic view of stereograms. The advantage of this procedure is that the roentgenograms can be viewed at rather short distances, that they present normal dimensions and that they can be viewed both orthoscopically and pseudoscopically without changing of the films.—*T. Leucutia*.

BRAUN, OSKAR. Der analytische Felderwähler. (The analytic field selector.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Nov., 1929, 40, 834-839.

The author describes a new method for field selection in deep roentgen therapy which consists in the mathematical calculation of the depth dose with the aid of the intensity law. Samples of curves are presented for the analytic determination of the number of fields and of the surface doses for various conditions.

In the near future a logarithmic slide rule will be prepared for the easier calculation of the values of the curves.—*T. Leucutia*.

FERNAU, ALBERT. Wie sollen Radiumträger beschaffen sein? (How to make radium carriers.) *Strahlentherapie*, 1929, 34, 855-858.

The author criticizes the radium carriers commonly used, particularly because the radiation from them is not homogeneous and because there is a great loss of radium in removing it for use elsewhere. He has had a carrier made which can be kept indefinitely and there is no loss on removal of the radium. It is a capsule made of nicked silver and may be made in various forms and sizes to be used for various parts. It is filled with potassium sulphate to determine the amount necessary to

fill the cavity which is then removed and mixed with the radium salt. The amount required is then introduced into the capsule with a metal funnel, the capsule closed and the lid soldered on. The metal wall that is to be placed on the part of the body to be treated is 0.3 mm. thick; the opposite wall is 3 mm. thick. When the radium is wanted for other purposes it can be removed almost without loss. The radium containing potassium sulphate is treated with dilute hydrochloric acid, on which the potassium sulphate goes into solution and the radium can be collected almost without loss as insoluble sulphate.

Needles are often not well filled either. They are filled from the tip and the radium collected in the opposite end of the needle leaving the tip free. If such a needle is used in a tumor of the mouth, for instance, the tip which is in the tumor has no effect and the part that protrudes outside and does contain radium may injure normal parts. The needles should be closed at the top with a cap that screws off and filled from the top; they should be filled under roentgen control so as to know just where the radium is. In filling tubes care must be taken to see that the filling is homogeneous and that the radium does not collect at one place or change its position. When radium carriers are bought they should be examined roentgenologically to see if they are filled homogeneously.

The author then describes the details of his chemical method of recovering radium without loss from needles; this is important as the price of radium is so high.—*Audrey G. Morgan*.

RISSE, O. Einige Bemerkungen zum Mechanismus chemischer Röntgenreaktionen in wässrigen Lösungen. (Mechanism of chemical roentgen reactions in aqueous solutions.) *Strahlentherapie*, 1929, 34, 578-581.

If water is irradiated with ultraviolet rays in an air-tight rock crystal vessel no hydrogen peroxide is produced but if it is irradiated with roentgen or beta radium rays hydrogen peroxide is produced. The question is whether the necessary oxygen for the formation of the hydrogen peroxide comes from the oxygen physically dissolved in the water or from the  $H_2O$  molecule. Experiment has shown that it comes for the most part from the dissolved atmospheric oxygen. When the water was boiled

for several minutes and closed air-tight before irradiation, hydrogen peroxide was not formed. So in examining the changes brought about by roentgen or beta irradiation in any substance dissolved in water unless atmospheric oxygen is carefully excluded the effect of the peroxide that is formed must be taken into consideration. Fricke's transformation of ferrosulphate into ferrisulphate illustrates this. It is logical to suppose that the transformation of a substance sensitive to roentgen rays would run parallel to its concentration. But Fricke's reaction was independent of concentration throughout a wide range, that is, the same amount of radiant energy transformed the same number of molecules, no matter whether there were 25 molecules to the cubic centimeter or more or less. Fricke concluded from this that the ferrosulphate molecule in itself is not sensitive to the rays, but is transformed secondarily by some product that develops in the water. Evidently hydrogen peroxide is formed first and reacts with the ferrosulphate. But Fricke saw a transformation even when oxygen was excluded, though it was only half as great as in the presence of oxygen. This must have been due to a chemical activation of the water by the rays. Hydrogen peroxide is also decomposed by roentgen, beta and ultraviolet rays. The author describes a method of calculating the decomposition of hydrogen peroxide quantitatively and the rapidity of such reactions as Fricke's ferrosulphate reaction and of obtaining evidence in this way as to whether a substance is transformed directly or indirectly by means of activated water.

The roentgen and beta rays may change water into atomic hydrogen and oxygen and two O atoms may combine to form molecular oxygen which is finally hydrated to  $\text{H}_2\text{O}_2$ . Or water may be split into H and OH and two of the OH groups unite to form hydrogen peroxide. In either case two H atoms remain which can again combine with molecular oxygen dissolved in the water to form hydrogen peroxide. The author is testing this hypothesis experimentally. It is obvious that such a decomposition in the body, which contains so much water, would be of the greatest importance.—Audrey G. Morgan.

DEL BUONO, P. Weitere Untersuchungen über die Wirkung der Röntgenstrahlen auf das

vegetative System. (Further studies of the effect of roentgen rays on the vegetative system.) *Strahlentherapie*, 1929, 34, 301-312.

While irradiation of other parts of the body causes leucopenia, fall of blood pressure and hypoglycemia, irradiation of the region of the hypophysis causes hyperleucocytosis accompanied by moderate hypertension and hyperglycemia. Irradiation of the hypophyseal region may cause an increase of tonus of the hypophysis or it may act on the vegetative centers of the midbrain which regulate blood pressure, glycemia and temperature. In that case irradiation of the hypophysis would cause an increase of sympathetic tonus, one of the effects of which is a rise of blood pressure. Glycemia is also increased by the action of the vegetative nerves on the liver cells in sympathicotonia. In the author's experiments on rabbits blood pressure was increased immediately after the irradiation by 0.05 to 0.10 per cent of the original value; after six hours by 0.10 to 0.20 per cent and after twenty-four hours the values were normal again. The author says there is a roentgen shock just as there is a colloidoclastic shock which causes leucopenia on irradiation of the body in general but the leucocytosis on irradiation of the hypophyseal region he thinks is caused by the action of the rays on the neurovegetative centers of the midbrain. To prove this absolutely it would be necessary to remove the hypophysis and irradiate the vegetative centers but this is technically impossible because it is hardly possible to remove the hypophysis without injuring the midbrain centers. But the experimental results indicate that it is action on the neurovegetative centers rather than on the hypophysis that causes the above-mentioned changes.—Audrey G. Morgan.

JUGENBURG, ANNA. Über die Einwirkung der Röntgenbestrahlung auf den Gasstoffwechsel. (Effect of roentgen irradiation on basal metabolism.) *Strahlentherapie*, 1929, 34, 288-300.

Experiments on guinea pigs are described which show that roentgen irradiation affects basal metabolism more or less, depending on the size of the dose used. General irradiation with doses as large as half an erythema dose which cause considerable lowering of basal metabolism and decreased intensity of oxida-

tion, bring about depression of nitrogen metabolism and retention of nitrogen in the organism. The changes in basal metabolism and nitrogen metabolism caused by roentgen irradiation with large doses are so rapid that the animals die fourteen to sixteen days after the irradiation. General irradiation with small doses causes a brief and slight depression of basal metabolism and oxidation. But after a comparatively short period of three to four weeks the basal metabolism shows a tendency to return to normal. In some cases after irradiation with small doses there was even an increase in the intensity of oxidation. On roentgen irradiation with small doses there was a considerable increase of the respiratory quotients, which suggests that irradiation causes increased oxidation of carbohydrate. In the cases in which the respiratory quotient increases to more than 1 after the irradiation, fat must be formed from carbohydrate. Irradiation of the abdomen of the guinea pig alone causes a considerable increase in weight and increased basal metabolism, without affecting the intensity of oxidation particularly. Irradiation of the head and neck in some cases causes a decrease in weight and a fall of basal metabolism; in other cases this form of irradiation does not have any special effect on basal metabolism.—*Audrey G. Morgan.*

RUBINSTEIN, D. L. Untersuchungen über Röntgensensibilisierung. I. Über den Mechanismus der Sensibilisierung durch Iodsalze. (Studies of roentgen sensitization. I. The mechanism of sensitization by iodine salts.) *Strahlentherapie*, 1929, 34, 414-420.

The technique of the author's experiments is described. Some authors think the biological effect of roentgen rays can be considerably increased by sensitizing substances. Substances are used as sensitizers that have a high atomic weight which on irradiation send out softer secondary rays and electrons. Iodine compounds are used particularly. The author has found however that it is not the iodine solution that increases the action of the roentgen rays, but the rays bring about a chemical decomposition of the solution, splitting off free iodine, which is extremely toxic, from its salts. This decomposition of the iodine salt is a roentgen chemical reaction brought about by the direct action of the rays. But under the

ordinary conditions of biological experimentation a much more important part is played by the indirect action of the rays, that is, oxidation of the iodine salt by the ozone formed in the air. If this chemical change in the solution is excluded by adding sodium hyposulphite no further sensitization takes place. Evidently the secondary rays and electrons sent out by the iodine atoms are not of any special importance.

Some practical medical facts can be explained in the same way. Melchior reported that when potassium iodide and roentgen rays were used at the same time their combined action on actinomycosis was increased. This increased therapeutic action was evidently due to activation of the iodine salt by setting iodine free.—*Audrey G. Morgan.*

SCHREUS, H. TH. Die Zerstörung des Cholesterins durch die Röntgenstrahlen in vitro. (The destruction of cholesterin by means of roentgen rays in vitro.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Nov., 1929, 40, 842-844. This article constitutes an answer to a recent publication of Roffo and Correa (see abstract, this Journal, September, 1929, p. 303) regarding the action of roentgen rays on cholesterin in 0.25 per cent solutions of chloroform. After repeating the experiments (according to the instructions of Roffo and Correa) the author found that the difference in his results and those of Roffo and Correa was due to the variation in the amount of radiation applied.

In reviewing the whole problem the author admits that the final results of investigations are identical in the two instances. An effect of the roentgen rays on the cholesterin is observed only in the presence of chlor-containing solutions. The action is primarily on the chloroform and only secondarily through the destruction products of the chloroform on the cholesterin itself. In 0.25 per cent chloroform solutions a larger amount of radiation is necessary to bring about the destruction of cholesterin than in the case of standard (0.02 per cent) solutions.—*T. Leucutia.*

BECKWITH, T. D., OLSON, A. R., and ROSE, E. J. The effect of x-ray upon bacteriophage and upon the bacterial organism. *Proc. Soc. Exper. Biol. & Med.*, Jan., 1930, 27, 285-286.

Seven strains of *B. coli* bacteriophage and

six strains of *B. coli* were used in the following experiment. The organisms were young cultures in the phase of positive logarithmic growth in beef infusion broth and the phages were recent filtrates in the same medium. These were contained in lead-free glass test tubes. Exposure to roentgen rays was carried out at a distance of about 14 inches from the target of a roentgen tube operated at 75 kv. The exposure was for 30 minutes. Following treatment each bacteriophage was placed in contact with untreated organisms of each culture and the exposed bacterial culture was set up with each of the unexposed bacteriophages. Suitable controls were run. By this treatment three of the phages developed reduced effectiveness when brought into contact with organisms shown previously to be susceptible to them in the control series. But this reduction in activity does not, of necessity, appear when this same portion of irradiated phage is brought into contact with other strains of the colon bacillus. The diminution of effect thus may be selective as the result of irradiation. Likewise in three instances treatment of the cultures reduced the activity of the bacteriophage upon them. Again the effect may be selective since this same treated suspension, when brought into contact with other strains of *B. coli* phage, may still show the usual lysis. The effect, therefore, cannot be ascribed to sterilization of the cultures in all instances for they were not killed by this treatment.—*B. Cohen.*

WYCKOFF, RALPH W. G., and RIVERS, THOMAS M. Effect of cathode rays upon certain bacteria. *Proc. Soc. Exper. Biol. & Med.*, Jan., 1930, 27, 312-314.

The organisms studied were *B. coli*, *Staphylococcus aureus* and *B. aertryke*. The cathode

rays were obtained from a Coolidge electron tube operated at about 200 kv. Small numbers of organisms were evenly spread upon the surfaces of agar plates and known areas were exposed for different lengths of time to the electron stream. After incubation, counts were made of the numbers of colonies growing out in these areas and in similar standard areas shielded from radiation. By estimating both the number of electrons which strike a bacterium in unit time and the absorption coefficient of these electrons in the bacterium, it is possible to analyze the observed survival ratios by the usual methods of probability theory. Such an analysis will show how many electrons may be stopped by a single bacterium before death results. It will also indicate whether absorption must take place in a particular portion of the organism in order to be lethal. When motile bacilli of mouse typhoid were spread on agar so that not more than about 200 cells were in the area of 1 square inch the results agreed with the conclusion that one electron-hit is sufficient to kill. This was only obtained when the effects of cell multiplication were eliminated by irradiating immediately after seeding the plates. The same results were obtained for the less motile colon bacillus. Even under the most favorable conditions *Staphylococcus aureus* required more than one hit. However, examination of the suspension showed that the cocci were still for the most part clustered. The data indicate that the only differences that exist in the resistance of these organisms to 200 kv. electrons are due to their relative sizes. To obtain valid results it is absolutely necessary to eliminate clumping of cells and to prevent multiplication before irradiation, requirements which have not been met by the experimental procedures hitherto followed.—*B. Cohen.*





# THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. XXIV

OCTOBER, 1930

No. 4

## THE ROENTGENOLOGIC DIAGNOSIS OF COARCTATION OF THE AORTA (ADULT TYPE)\*

By WALTER W. FRAY, M.S., M.D.  
ROCHESTER, NEW YORK

THE diagnosis of coarctation is rarely made during life, though post-mortem experience would indicate that this condition is not extremely uncommon. King<sup>7</sup> noted that only 4 cases have been recognized clinically at the Johns Hopkins Hospital during the course of thirty-seven years. Abbott<sup>1</sup> in an exhaustive review of the literature, in which a total of 200 autopsied cases are carefully analyzed, found that a virtual diagnosis of obstruction of the thoracic aorta had been made in 28 cases and of these 21 were diagnosed as definite coarctations. Thus in approximately 86 per cent of the cases the diagnosis was missed clinically and autopsy was required to identify the condition.

We have recently had the opportunity of making a complete roentgen study of 2 cases of coarctation and are presenting the findings in some detail. We intend to show that this condition offers certain definite roentgenologic features, upon which the diagnosis can be successfully established.

The roentgenologic aspects of this anomaly have not been definitely considered in the past by roentgenologists but have been discussed by clinicians, whose opinion of the roentgen diagnosis is not based upon modern roentgenologic knowledge or technique.

Reports in the literature dealing with its clinical aspects express a very pessimistic attitude concerning the help which a roentgen examination may give. King<sup>7</sup> states that "roentgenograms are disappointing," adding that the location of the coarctation behind the cardiovascular stripe makes it an unfavorable site for inspection and concludes that "the chief value of the roentgen-ray is the ruling out of aneurism." Blackford<sup>3</sup> writes a similar opinion: "Roentgenologic examination of the thorax is of value in excluding aneurysm which has been the most common erroneous diagnosis but the presence of aneurysm does not exclude coarctation." He adds that it is also of some value in excluding intrathoracic neoplasm.

Roentgenologic periodicals, textbooks and monographs (Vaquez and Bordet,<sup>15</sup> Köhler,<sup>9</sup> Holmes and Ruggles,<sup>6</sup> and others) dealing with roentgen diagnosis either do not mention the condition or give no satisfactory criteria upon which to base the diagnosis. There is therefore very little opportunity for the roentgenologist to familiarize himself with the differential diagnosis of coarctation, though the recent articles of Abbott,<sup>1</sup> and Railsback and Dock<sup>13</sup> have aided in this regard.

The roentgenologist has an excellent opportunity to make this diagnosis, entirely

\*From the Department of Radiology, Strong Memorial Hospital, and University of Rochester, School of Medicine and Dentistry, Rochester, N. Y.



unaided by clinical or laboratory data. It should be possible to establish the diagnosis in practically every case in which a complete roentgen examination of the heart

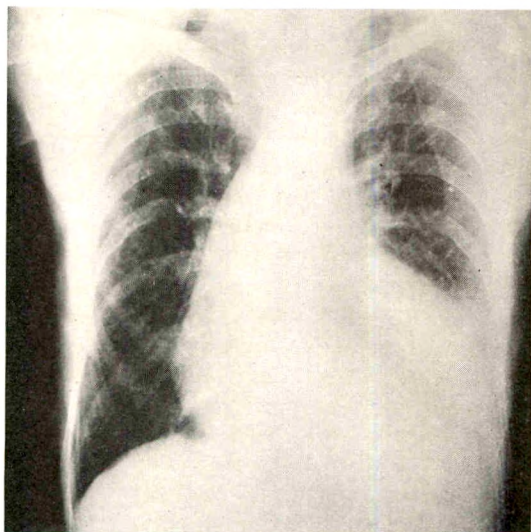


FIG. 1. Case 1. Roentgenogram of the chest taken in the posteroanterior position. Note the absence of the aortic knob, the presence of a left ventricular hypertrophy, the prominence of the ascending aorta and the erosion of the ribs.

and aorta can be made. The manner in which this can be accomplished, together with an analysis of the diagnostic features, will be discussed in detail after the presentation of 2 cases.

In the following two case reports only the data relative to the condition of the coarctation and its diagnosis will be given.

**CASE 1.** R. D., male, white, single, aged fifty-seven, entered the Rochester Municipal Hospital on Dec. 8, 1927, complaining of anorexia and weakness of two weeks' duration. He had always enjoyed good health, supported himself and worked as an employee in a button factory. There was no significant history of infections such as rheumatic fever or tonsillitis. He had, however, been refused life insurance eighteen years previously, and occasionally in the past had noted a "fluttering" of his heart, and for fifteen or twenty years had noted some dyspnea on exertion. His family history was negative.

His present illness began rather insidiously

with feverish sensations, anorexia and weakness. Dyspnea became more marked and nocturia developed. He had been forced to quit work five days before his admission and had lost 10 pounds in weight.

Physical examination showed a thin, undernourished adult male. The teeth were in poor condition. Pulsating neck and thoracic vessels were particularly marked in the supra-sternal notch and right supraclavicular region, and there were also large tortuous pulsating vessels in the axillae and over the scapulae. The chest showed a limited excursion with impairment of percussion note, a few rales and suppressed breath sounds at the left base. The heart was diffusely enlarged, with a forceful apex beat and a systolic thrill, palpable over the aortic region and apex. The first sound was booming while the second sound was heard only over the pulmonic area. A loud systolic murmur was heard over the entire precordium, varying in character according to the location. At the left nipple there was a constant to-and-fro murmur. The liver was palpable 3 cm. below the costal margin. Deep reflexes were sluggish throughout. The retinal vessels were moderately sclerosed. Temperature, 35.3°–40°C.; pulse, 80–130; blood pressure, 122/86.

Laboratory data obtained were as follows: Blood: hb., 100 per cent; red blood cells, 4,570,000; white blood cells, 21,900. Smear normal. Urine: trace of albumin; many granular casts; white and red blood cells in sediment. Sputum negative for tubercle bacilli. Vital capacity 1700. Phenolsulphonphthalein test 60 per cent in three hours. Blood culture: 4–20 colonies of *Streptococcus viridans* per c.c. Electrocardiograph: auricular fibrillation; intraventricular block.

**Roentgenologic Data.** Chest examination (posteroanterior, left and right posteroanterior oblique films, Figs. 1 and 5) was made on Dec. 10, 1927, approximately five weeks before death. Both the apices and infraclavicular regions showed changes suggestive of an old pulmonary tuberculosis. The right diaphragm was irregular in contour as a result of adhesions. The left diaphragm could not be identified, owing to the greatly enlarged heart, the apex of which reached the left lateral chest wall. The heart appeared enlarged in all of its diameters, the hypertrophy of the left ventricle being particularly massive. The width across the base of

the heart was increased and the auricular dilatation was so pronounced as to suggest a tricuspid insufficiency. The supracardiac area was greatly increased and this to a large degree was due to the prominence of the ascending aorta. One of the striking features noted at this examination was the complete absence of the aortic knob, a remarkable finding for a man of fifty-seven years. The cardiac measurements were: great vessels, 8.5 cm.; longitudinal diameter, 22.5 cm.; transverse diameter, 19.8 cm.; width of auricles, 15.5 cm.; internal diameter chest, 25.5 cm. These findings were summarized as follows: generally dilated and hypertrophied heart with massive left ventricular hypertrophy and extreme auricular dilatation, the latter being more marked on the right, suggesting a tricuspid insufficiency. The absence of the aortic knob and failure to visualize a considerable portion of the arch in the left oblique view suggested a congenital anomaly of this vessel, but a definite diagnosis of coarctation was not made at the original examination. Other findings were diaphragmatic adhesions, apical scarring of tuberculosis and probable small effusion in left pleural cavity. A peculiar notching of one of the ribs was noted but its significance was not recognized at the time.

From the day of admission, the temperature varied in wide swings, gradually reaching a peak of 40°C. The pulse varied in proportion, with an average of 100. The patient gradually grew weaker and heart action became more labored. The first sound was finally entirely replaced by the murmur. Emaciation became more marked and death occurred, without further roentgen examination, on Jan. 17, 1928.

*Clinical Diagnosis.* Coarctation of aorta. Acute pancarditis (*Streptococcus viridans*). Left pleural effusion. General arteriosclerosis. Acute nephritis.

*Autopsy*—Jan. 18, 1928, by Dr. G. H. Whipple. Résumé of findings of the heart and lungs.

The pleural cavities showed dense adhesions at the apices; the pericardial cavity was obliterated by partially organized adhesions which were fairly tough but not dense. The pericardial layers showed definite rusty staining, suggesting digested blood.

Heart. Measured at least 14 cm. transversely in situ; weight 730 gm. together with pericardium and great vessels. The hypertrophy affected the left ventricle particularly. The

right auricle was distended and thickened; the coronary sinus was distended to twice or three times its normal diameter. The tricuspid ring was greatly dilated, the orifice of which was practically filled with a cauliflower-like mass of vegetations adherent to the ring, which appeared to protrude from this region rather than adherent to the valves. It was found that this enormous mass of vegetations came from the extension of the primary process back of the aortic leaflets. The leaflets of the tricuspid were thin, delicate and uninvolved. The right ventricle was found moderately hypertrophied and dilated. The intima was smooth, the muscle normal. The pulmonary artery showed no arteriosclerosis. It was almost completely occluded by thrombus masses, probably by extension from below or by fragments from the tricuspid valve region. Several of the smaller pulmonary vessels were also plugged with thrombi.

The left auricle was greatly dilated and hypertrophied. The mitral ring was not dilated. The valve leaflets in general were normal but there were two old scars which joined the bases of the two mitral leaflets, narrowing the orifice a little. This area, however, was closed over with smooth endothelium. It appeared to be a healed injury (related to the aortic injury) from which healing has been almost complete, with return to normal. The left ventricle was a little dilated and showed great hypertrophy of the muscle wall, measuring over 2 cm. in thickness. The papillary muscles showed scars at their tips and on tangential section the heart muscle showed everywhere gray and silver patches, usually of small size. The aortic region showed extreme deformity of the valves and vegetations on the under surface. Opened from above, the aortic ring showed great deformity with only a small button-like opening about 1–1.5 cm. long. Two of the leaflets sagged away from their common point of insertion with fusion of these cusps into one large, deformed, calcified cusp which formed one side of the opening. The other cusp was similar in form and thickened with a round rolled margin. Below this rounded margin in both angles were found rough granular vegetations. There was quite a mass of these vegetations, some of them having a slaty gray color.

It was believed that the inflammatory process had spread through the interventricular



tissue to form the fungous vegetations at the site of the tricuspid ring. There was a small distinct passage from the vegetations just below the aortic cusps to the center of the tricuspid vegetations.

The aorta showed a moderate amount of arteriosclerosis in its arch. An enormous innominate artery was seen from which a mammary vessel, measuring 5 or 6 mm. in diameter, arose. This vessel, which on section showed definite calcification of the media, was thickened, tortuous, and ran down along the inner surface of the manubrium, anastomosing with the hypogastric through arterioles which were at least 3-4 mm. in diameter. The carotid going to the left side came off the arch in the normal way and was about normal in size. The subclavian, on the other hand, was 2-3 times its normal size and gave off a large mammary artery, anastomosing as the other one. Following the aorta, just beyond this third branch, one came to a blind pocket (Fig. 2). The aorta began again after a space of about 1-1.5 cm.

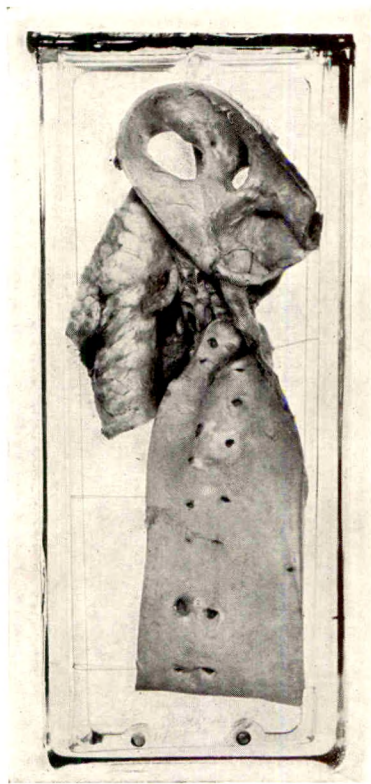


FIG. 2. Case 1. Autopsy specimen illustrating the complete atresia of the aorta. Note the dilated openings of the upper intercostal arteries.

as a blind pouch into which opened several intercostals which were enormously dilated, some of the larger ones measuring 6-7 mm. in diameter. Some of the thoracic intercostals 6-8 cm. below this were also dilated and evidently afforded collateral supply. Arising from the convexity of the arch about opposite the left carotid was a puckered dimple from which a fibrous cord ran to the region occupied by the upper blind end of the thoracic aorta. This obviously was either the strictured portion of the aorta or the remains of the ductus arteriosus. The abdominal aorta was decidedly hypoplastic, quite elastic, thin walled, and obviously did not carry the normal amount of blood. The renal arteries were smaller than normal. The common iliacs were small and there was much less sclerosis here than in the hypogastrics.

**Lungs.** The left lung was small, flabby and decidedly atelectatic. There was no great excess of fluid in the pleural cavity, though there may have been a small amount. The lung showed an old tuberculous focus in the apex, covered by adhesions. The lower lobe showed a flabby doughy lung tissue almost free of air. There were one or two hemorrhagic infarcts in this area. The pulmonary artery going to this lower lobe was almost completely occluded by an organizing thrombus and it was believed that a part of the atelectasis was due to shutting off of the blood supply. The right lung by contrast was quite heavy and voluminous. It also contained a fibroid apical scar of healed tuberculosis. The middle and lower lobes showed typical hemorrhagic infarcts. The lung tissue adjacent was very wet and boggy, showing much edema. Some of the thrombous masses in the small vessels showed softening in their centers suggesting infection. The pleural surfaces over some of the infarcts showed a beginning inflammatory reaction.

*Complete Anatomical Diagnosis.* Aortic anomaly with stricture (coarctation). Hypertrophy and dilatation of collateral arterioles. Arteriosclerosis. Subacute aortic endocarditis with stenosis. Ulcerative aortic endocarditis with extension into the tricuspid ring. Chronic endocarditis (mitral). Extreme cardiac hypertrophy and dilatation with diffuse fibrous myocarditis. Organizing obliterative pericarditis. Emboli and thrombi of pulmonary artery with extensive infarct formation, particularly



in right lung. Thrombosis of prostatic plexus. Pulmonary edema and acute pleuritis. Bilateral apical scars of lungs with chronic adhesive pleuritis. Emphysema. Multiple duodenal ulcers with acute fibrinous peritonitis. Hemorrhage into intestines. Chronic adhesive peritonitis. Encephalomalacia. Surface atrophy of liver. Thyroid adenomata. General emaciation.

**CASE II.** R. W., male, white, married, entered Strong Memorial Hospital on July 23, 1929, complaining of hot painful swelling of the left foot of two months' duration.

The onset of the swelling was sudden and occurred without any obvious cause. It was painful even when quiet but was made worse on motion. The foot became red only after soaking it in mustard water. After a week of rest, it gradually improved without any specific treatment. Twice since the onset the swelling had recurred and on one occasion vesiculation of the skin followed the use of mustard baths. The patient had no other complaint except he was 13 pounds under his usual weight.

His past history was essentially negative, without history of rheumatic fever, chorea or frequent sore throats. He noted dyspnea only on greatest exertion. He had not noted palpitation, chest pains or chronic cough. The family history was non-contributory.

On physical examination the patient appeared to be a healthy well-developed, fairly well-nourished adult male, not acutely ill. The left ankle and foot were hot, swollen and covered with small vesicles. The upper border of the red area formed a distinct line immediately above the malleoli. Motion of the joint caused no pain. The lungs were clear. A marked diffuse systolic impulse was noted over the entire precordium, maximal over sixth interspace, 13.5 cm. from mid-sternal line. The heart was greatly enlarged to the left and downward. Heart sounds were forceful. A loud diastolic murmur was heard best over the aortic area. The dorsal scapular arteries and the intercostal and epigastric arteries were enlarged and pulsating. No pulsations could be felt in the abdominal aorta, femorals or popliteals, and only a weak pulsation was palpable in the posterior tibials and dorsalis pedis arteries. Radial pulses were of the Corrigan type. Abdominal examination was negative.

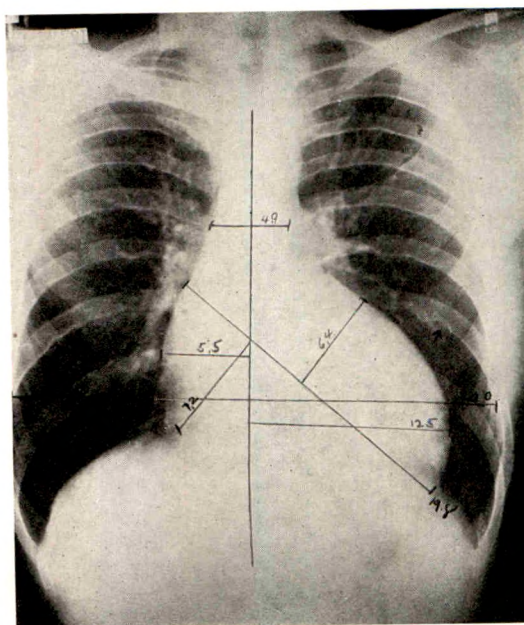


FIG. 3. Case II. Roentgenogram of the chest taken in the posteroanterior position, showing findings similar to those of Case I. The rib erosion is better illustrated in this case.

Reflexes active. Temperature, 37.5°C.; pulse, 88; respiration, 22; blood pressure, 190/80.

**Laboratory Findings.** Blood: red blood cells, 5,510,000; white blood cells, 8,400; hb, 102 per cent. Differential count and smear normal. Urine: very heavy trace of sugar; diacetic acid test positive. Stool: negative. Blood chemistry: sugar, 149; nonprotein nitrogen, 42; Wassermann reaction, negative. Electrocardiograph: Left ventricular preponderance; first degree heart block; myocardial damage. Sugar tolerance test: fasting, 85;  $\frac{1}{2}$  hr., 131.2; 1 hr., 168, and 2 hr., 172.4. Blood culture: negative.

**Roentgenologic Data.** Routine posteroanterior and left and right posteroanterior oblique films of the thorax were made (Figs. 3 and 6). Both apices appeared clear. The contour of the left diaphragm was slightly irregular suggesting adhesions. The heart and great vessels were of chief pathological interest. The heart was enlarged in all of its diameters, particularly in its transverse and longitudinal diameters, its shape suggesting a massive left ventricular hypertrophy and moderate auricular dilatation. In the posteroanterior film, the configuration of the aorta appeared distinctly abnormal. The



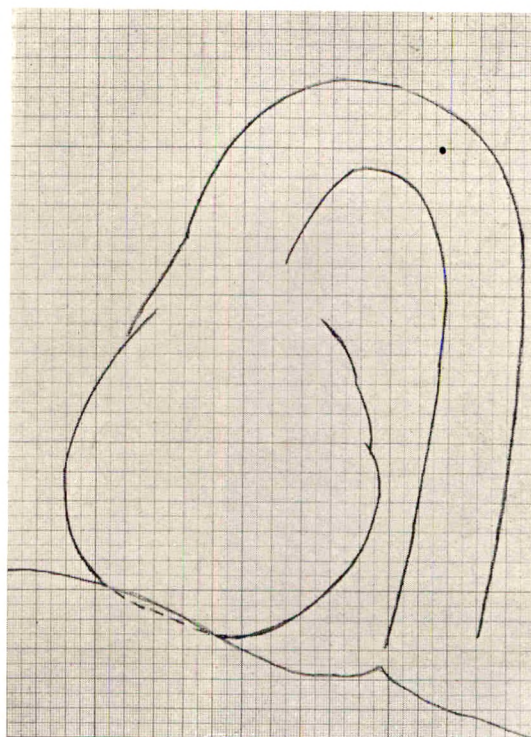
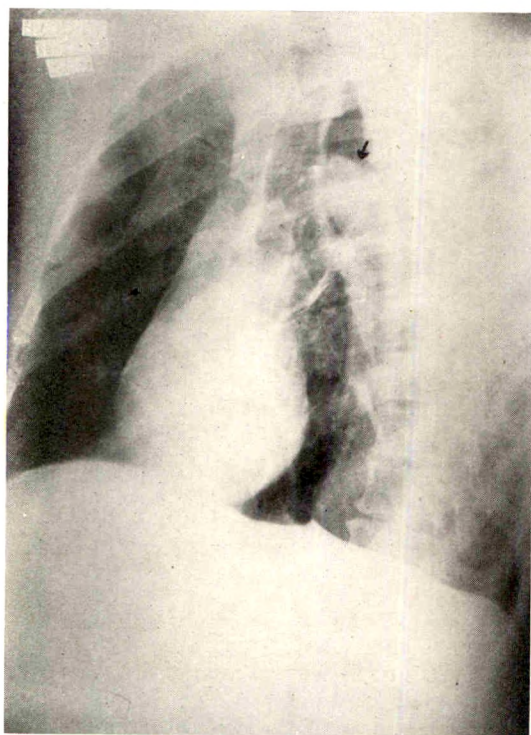


FIG. 4. Roentgenogram (untouched) of chest taken in the left posteroanterior position, with drawing showing normal aorta (for purposes of comparison). Note the sharp definition of the arch at the arrow.

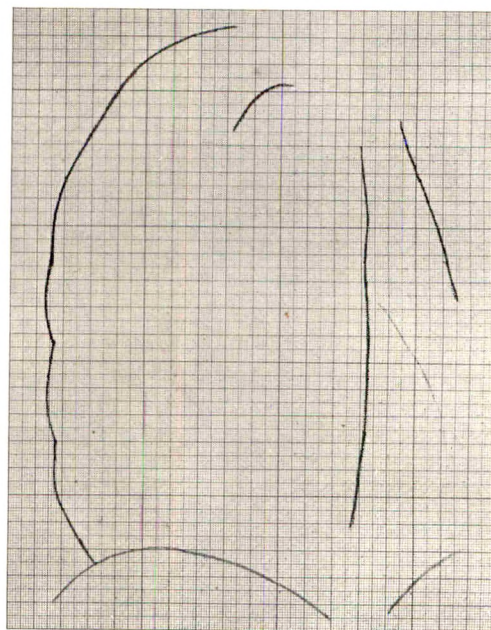
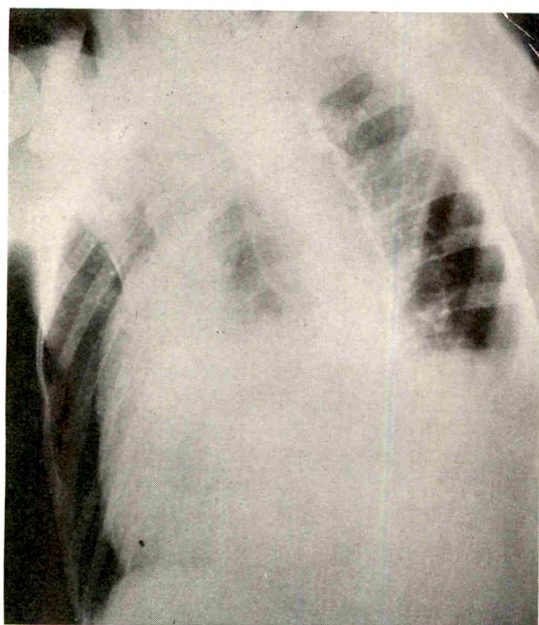


FIG. 5. Case 1. Roentgenogram (untouched) of chest taken in the left posteroanterior oblique position, with drawing illustrating the defective arch. The left pleural effusion obscures the apex of the left ventricle; the dilated ascending aorta is evident.



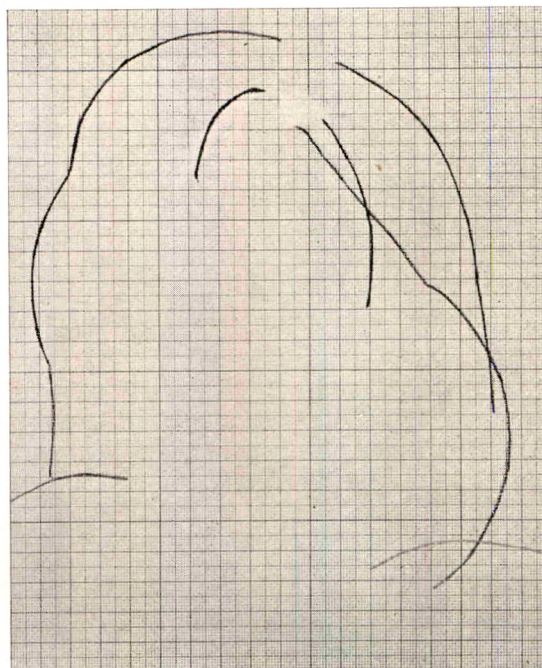
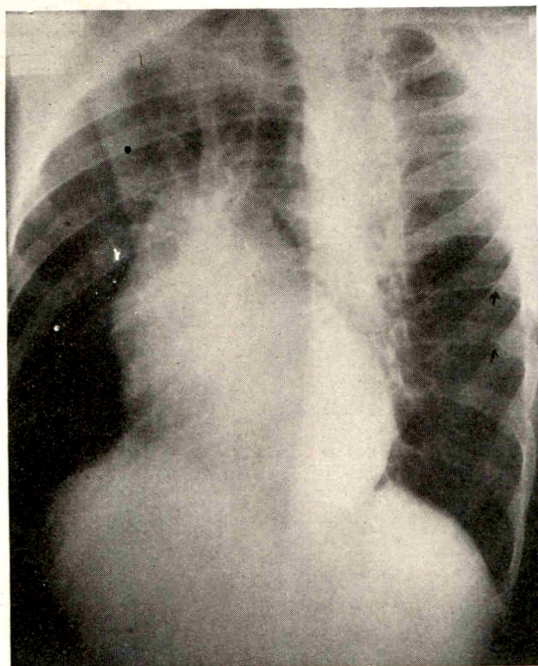


FIG. 6. Case II. Roentgenogram (untouched) of chest taken in the left posteroanterior oblique position, with drawing illustrating the defective arch. The massive left ventricle, the dilated ascending aorta and rib erosion are also shown.

ascending aorta was moderately dilated and the aortic knob entirely absent. In the left posteroanterior oblique film, the transverse portion of the arch could be outlined, but as the descending limb of the arch was reached the shadow faded out and became very indistinct. This suggested that the descending limb was at least in part obliterated and that the dilatation of the ascending aorta was secondary to this obstruction. A striking feature, noted at the time of this examination, was the erosion of several of the ribs on both sides, undoubtedly due to blood vessel pressure and definitely suggesting collateral circulation, carrying a large volume of blood. Bone erosion was noted at the seventh and ninth right ribs and the fifth, eighth and ninth left ribs posteriorly. The cardiac measurements were: great vessels, 4.9 cm.; longitudinal diameter, 19.8 cm.; right media, 5.5 cm.; left media, 12.5 cm.; width auricles, 13.6 cm.; internal diameter chest, 30.0 cm. The roentgen findings were summarized at this examination as a coarctation of the aorta (adult type) based upon the following four features: absence of aortic knob in the posteroanterior view; dilatation of the ascending

aorta; absence of a portion of the aortic arch in the oblique view; marked enlargement of the left side of the heart and rib erosion as a result of a collateral circulation involving the intercostal arteries.

*Course in the Hospital.* Except for slight rise in temperature for the first few days, the temperature, pulse, and respirations were normal. He was kept in bed with the left foot elevated and in five days it was practically normal. His mild diabetes was easily controlled by diet and he was finally raised to a diet of 2500 calories. It was suggested that the swelling of the left foot was due to circulatory disturbance. Discharged to his local physician after fourteen days in hospital.

*Clinical Diagnosis.* Coarctation of aorta (adult type); diabetes mellitus (mild).

*Subsequent Note.* This patient died at home with signs of a cardiac decompensation eight months after his discharge. Autopsy permission was denied.

A summary of these two cases shows many points of similarity. Both were male adults without previous history of rheu-

matic fever, chorea, or lues. Neither gave any history of repeated cardiac breaks. Both had always been self supporting and had worked up to the time of their present illness, one as a worker in a factory, the other as a clerk. Clinically both showed evidence of a collateral circulation.

Roentgen studies obtained by the technique described below, showed five fundamental points in common: (1) Absence of aortic knob in posteroanterior view; (2) defect in aortic arch in left posteroanterior oblique view; (3) rib erosion in both views; (4) dilated ascending aorta, and (5) left ventricular hypertrophy.

#### ROENTGENOLOGIC TECHNIQUE

If coarctation is suspected, a very careful roentgenoscopic examination of the thoracic aorta should be made from all angles, searching particularly for a defect in the continuity of the arch, unusual pulsations and dilatation of the ascending aorta, with possible aneurysm from dilatation of the weakened wall proximal to the obstruction, collateral circulation changes with enlargement of the vessels in the superior mediastinum, and finally, erosion of the ribs posteriorly. The usual routine posteroanterior film and a left posteroanterior oblique film of the chest should be obtained. The latter should be made with the patient in the proper position to outline the aorta to its greatest extent. This will usually be obtained when the patient is rotated clockwise from the usual posteroanterior position 35-60°, depending upon its appearance during the roentgenoscopic examination. The left clavicle is approximately parallel with the film in this position. Stereoscopic films would probably be an advantage.

#### DIAGNOSTIC FEATURES OF COARCTATION

Coarctation of the aorta has been thoroughly studied by the pathologists who have demonstrated the common characteristics of this anomaly. These well-defined changes are such as to permit identifica-

tion by modern roentgen technique. Given suitable opportunity to make a complete and satisfactory roentgen examination, it should be possible to establish the diagnosis upon the basis of these pathological changes.

These signs of coarctation may be conveniently divided into two general classes. (I) Direct signs—those relating directly to stenosis or atresia. (II) Indirect signs—those changes which give indirect evidence of obstruction such as the presence of a collateral circulation, cardiac hypertrophy and dilatation of the ascending aorta.

There are two primary signs: (1) Absence of the aortic knob in the posteroanterior chest film, and (2) defect or break in the continuity of the arch of the aorta at the descending limb in the left posteroanterior oblique chest film.

(1) *Absence of Aortic Knob in the Posteroanterior View.* The first of these has been noted previously by Abbott. The usual posteroanterior film of a normal adult chest shows a rounded eminence due to the aorta to the left of the spine at the level of the fifth dorsal vertebra. This becomes more prominent with age, and in later life may present a conspicuous knuckle or semicircular shadow projecting beyond the rest of the aorta, its prominence being greatly enhanced by the arteriosclerotic changes. This aortic knob, representing the junction of the transverse portion and descending limb of the arch, is absent in cases of coarctation because it represents the site of the isthmus which is the part of the arch involved by this anomaly.

The absence of the knob, therefore, in an adult, suggests a stenosis or atresia of the aorta and affords direct evidence which is sufficient in itself to lead to a complete cardiac roentgen study with oblique views, particularly the left posteroanterior oblique. In an elderly subject in whom a prominent knuckle would be expected, its complete absence should arouse immediate interest (Figs. 1 and 3). It was this latter finding in a man of fifty-seven which first



led us to suspect an anomaly of the aorta in our first case. It should be noted, however, that in early life this aortic shadow is normally absent or very inconspicuous. The sign is not pathognomonic and cannot be subjected to universal application. This change, however, was sufficient in a boy in his early teens (case of Hamilton and Abbott<sup>2</sup>) to be of aid in the diagnosis. It undoubtedly is a very valuable sign in adults.

. (2) *Defect in Arch in Left Oblique View.* Cases published up to the present time which are accompanied by reproductions of the roentgenograms of the heart show that the films have been made in the conventional posteroanterior view.

A clear view of the arch of the aorta is necessary in order to study that portion of the arch which is involved in cases of stenosis or coarctation. The left posteroanterior oblique chest film, if technically satisfactory, shows practically the entire aortic arch. This view or the similar right anteroposterior oblique film should be obtained in every case in which a complete study of the heart and vessels is to be made. This view has been of particular interest for the study of other types of aortic disease such as arteriosclerosis, dilatation and aneurysm, but to our knowledge it has not been used in cases of coarctation, though its importance in such cases is manifest.

Coarctation will show a defect or break in the continuity of the aortic outline at the upper end of the descending limb of the arch. The defect is short in length (only 1-2 cm.) and anatomically located, in most cases, in that portion of the arch below the subclavian, at or slightly below the point of connection between the ductus arteriosus and the aorta. A complete stricture may not be evident for in many instances there is a narrowing or stenosis only. Abbott<sup>1</sup> in summarizing 200 cases, found only 47 completely atresic, while 108 were extremely stenotic and 45 moderately stenotic. A considerable column of blood must be passing through the

stenotic section to permit the casting of an outline of it on the film. Cases of extreme stenosis or atresia will show little or no blood in the narrowed portion and hence, on the film, one notes a break in the continuity of the arch. In cases in which the stenosis is slight or moderate, an indentation of the arch will be observed which is usually sharply localized in the descending limb and the outline of the aorta comes to an abrupt ending. The indentation anatomically is usually more conspicuous on the convex side of the arch, and this is a fortunate circumstance, since roentgenographically the convexity of the arch in the oblique view is much more sharply delineated than its opposite margin.

A defect or break in the continuity of the arch in the region described is pathognomonic of coarctation. No other condition of which we are aware will produce this result. Arteriosclerosis, dilatation secondary to hypertension and aneurysm produce radically different shadows. These, particularly the last two, tend to accentuate or add to the aortic shadow. In a few rare congenital disorders, such as persistent truncus arteriosus and aortic atresia, the aorta may be absent or hypoplastic, but in these cases the defects or changes in the aorta are of a generalized or diffuse character and marked in degree. The localization of the defect in the descending limb of the aortic arch will serve to differentiate coarctation from the generally hypoplastic aorta in most instances. In approximately 10 per cent of the 200 cases collected by Abbott, the proximal aorta was somewhat narrower than normal, but in most of these cases the aorta was probably carrying a sufficiently heavy column of blood to permit outlining the arch up to the point of stenosis.

The left posteroanterior oblique film was of prime importance in establishing the diagnosis in both of our cases, the break in the continuity of the arch being evident in both (Figs. 5 and 6). The aorta of the

R

one which was examined post-mortem was completely atresic permitting the passage of no blood through the narrowed portion and ending as a blind pocket (Fig. 2). The loss of continuity of the arch in the film, therefore, finds a satisfactory anatomical basis. It is probable that the aorta of the other patient was similar to the first (either extreme stenosis or atresia), for the aortic arch could not be identified at its descending limb.

The great advantage of the oblique view is obvious in the study of coarctation in youth. The absence of the aortic knob in the posteroanterior film in youth is not a reliable sign because of its inconspicuous character in normal subjects, but the demonstration of a local defect in the oblique view makes the diagnosis certain. Satisfactory oblique films have been obtained in this clinic not only in children but even in infants.

Passing now to the secondary changes, evidence of which may be obtained from a study of the roentgenograms, there are three findings of importance: (1) Hypertrophy of the left ventricle; (2) dilatation of the proximal aorta, and (3) erosion of the ribs.

(1) *Left Ventricular Hypertrophy.* Cardiac hypertrophy, especially of the left ventricle, is commonly associated with coarctation, though it is not a necessary accompaniment even when the defect in the aorta is marked. Abbott<sup>1</sup> noted it in 75 per cent of all cases. Autopsied cases often show a dilatation or hypertrophy of other chambers of the heart which may be due to a superimposed endocarditis or to congestive failure. The latter is the commonest cause of death and results in the enlargement of both the right and left sides of the heart, though the enlargement of the left ventricle is more pronounced. Our first case showed, at autopsy, a particularly heavy, massive left ventricle, a dilated and hypertrophied left auricle, and moderate enlargement of the right auricle and ventricle. Extensive endocarditis

about the aortic and tricuspid valves was also present. The origin, therefore, of the hypertrophy is often not simple nor due to a single cause, and the finding roentgenographically of a left ventricular hypertrophy is corroborative evidence only. For the determination of a left or right ventricular preponderance, the left posteroanterior oblique film is of much greater value than the usual posteroanterior view.

(2) *Dilatation of Proximal Aorta.* That portion of the aorta proximal to the stenosis is commonly dilated. In 101 of the 200 cases reviewed by Abbott, this dilatation was sufficient to be mentioned, while in only 28 cases was it noted to be hypoplastic or normal (hypoplastic, 21 cases; normal, 7 cases). Both of our cases show a dilated ascending aorta in the posteroanterior and left posteroanterior oblique views. It should be remembered, however, that in 10 per cent of Abbott's series the ascending aorta was hypoplastic, and this evidence or sign may be absent. When present, it indicates an intravascular hypertension proximal to the coarctation (probably associated with congenitally weakened arterial walls), and is often correlated with the clinical finding of high sphygmomanometer readings obtained from the upper extremities. The descending thoracic aorta immediately below the stenosis is often dilated, due to the return of the collateral circulation through the aortic intercostals. The descending aorta in our first case at autopsy appeared to carry a smaller volume than normal due to the extensive collateral circulation through the mammaries and hypogastrics, but it was difficult even on a review of the films to gain any definite roentgen evidence of this. Aneurysm, often of the dissecting type, is not an infrequent complication, usually involving the ascending aorta but was not noted in either of our cases.

(3) *Rib Erosion.* Rib erosion was first noted at autopsy by Meckel early in the nineteenth century. Cragie<sup>4</sup> (1841), in summarizing the literature, describes Mec-

kel's case including an illustration of the collateral circulation involving the upper intercostal arteries. These arteries are shown as greatly dilated tortuous vessels which have eroded the upper margins of several of the ribs in much the same manner as an aneurysm erodes bone (such as the spine and sternum). The finding of rib erosion, then, has been well known to pathologists for many years. Railsback and Dock<sup>13</sup> have recently shown that this rib erosion may be demonstrated roentgenographically. In fact, it was this finding which gave the clue to the diagnosis in their case. This erosion occurred along the lower margin of the ribs posteriorly and was bilateral. In both of our cases, this erosion could be identified. When the first case was interpreted the irregularities in one of the ribs was noted, but its significance was not appreciated. In the second case, the erosion of the ribs was definitely correlated with the collateral circulation. Our films were obtained with the anterior portion of the chest against the film so that the posterior ribs are not so well shown as the anterior ribs. In spite of this, all of the films show unmistakable evidence of costal erosion by blood vessel pressure.

The characteristics of these rib defects (Fig. 7) from a study of our films are as follows: (1) The defects are multiple, affecting more than one rib and not infrequently producing multiple defects of the same rib. (2) They are bilateral, affecting particularly the posterior portions of the ribs. (3) The lower margin of the rib only is affected. (4) The sulcation is smoothly curvilinear, never angulated or rough. (5) Simple erosion of the rib occurs where it is in contact with the artery without any alteration in bone trabeculation or other evidence of pathological change elsewhere in the rib. (6) New bone formation is essentially absent, though occasionally the sulcated margin may be brought out into striking relief by a smooth line of increased density in the deeper portion of the sulcation: (7) Pathological fracture has not

been noted, though erosion may involve half of the diameter of the rib or more.

There is very little likelihood of these being confused with other defects of ribs. It should be remembered that the first



FIG. 7. Case II. Reproduction to show the local erosion of two ribs of left posterior thorax.

pair of ribs normally possess a separate groove for the subclavian artery and vein, and some films show these grooves prominently. However, these grooves affect the anterior portion of the ribs on their superior aspect and of course will not be noted below the first rib. Occasionally an aneurysm may erode ribs but these defects will be sharply circumscribed and limited to the site of the aneurysm; the involvement is practically never diffuse or bilateral. A mediastinal tumor may by its growth produce obstruction, but this is usually to the venous return and the collateral circulation which commonly results



affects the veins of the thorax rather than the arteries. These dilated veins do not erode bone. Traumatic deformities and congenital anomalies offer no opportunity for confusion.

Rib erosion, though a secondary manifestation of coarctation, is practically pathognomonic of it. Not every case of coarctation, however, will show a collateral circulation. This will depend to a large extent upon the degree of the stenosis and in part on its duration, i.e., the patient's age. The actual incidence of a collateral circulation is difficult to determine from autopsy statistics because very often no mention of either its presence or absence is made. Blackford states that he was able to find only 8 cases in which no such circulation was found, when a search was made. A latent case without a collateral circulation has been recently described by Sala and Nachamie<sup>14</sup> in an infant of six months, dying of bronchopneumonia. Occasionally an adult may fail to show a collateral circulation, but in this type of case the stenosis is usually mild in degree and the passage of blood through the stenosed portion is adequate without the establishment of an auxiliary circulation. Such an individual is usually free of symptoms and the recognition of the anomaly is not so important as in those showing a more marked stenosis.

The extent of rib erosion will also depend on the course of the collateral circulation, being present only in those cases in which the aortic intercostals are involved. The collateral circulation is commonly between the superior intercostal (branch of the subclavian artery) and the first aortic intercostals, and also between the scapular branches of the thyreo-cervical trunk of the subclavian and the aortic intercostals. Less often or to a less extent the anastomosis between the internal mammary artery (branch of subclavian) and the inferior epigastric artery (branch of external iliac) is developed. The flow through the latter route will not produce rib erosion. It is interesting to note that

in our autopsied case there was a marked collateral circulation through this route but nevertheless the collateral through the aortic intercostals was sufficient to produce numerous defects of the ribs. It is possible too for the intercostal branches of the internal mammary to form a collateral circulation with the aortic intercostals. In this event one might expect erosion of both the anterior and posterior portions of the ribs. Such a case has not been noted up to the present time.

Rib erosion therefore will not be found in every case of coarctation but will be commonly seen in those cases in which a considerable collateral circulation has been established through the aortic intercostals. When present in characteristic fashion it alone is sufficient to make the diagnosis certain; when absent, coarctation cannot be ruled out without demonstrating an intact aortic arch in the left oblique view.

With these features in mind, the diagnosis of coarctation will not be a difficult matter and there will be but little opportunity for confusion with other disorders. In tumors one may demonstrate a mediastinal mass, an intact arch, and the absence of rib erosion. Aneurysm may occur in cases of coarctation so that the demonstration of an aneurysmal mass of course in no way rules out the additional possibility of coarctation. Aneurysms without coarctation do not produce rib erosion except locally at the site of the mass, and a sufficient collateral circulation is not established. In rare instances a generalized hypoplasia of the aorta may occur, such as the case recently described by Philpott<sup>11</sup> which was associated with a persistent thymus and lymphoid hyperplasia. Such a case would be expected to show an aorta of small diameter throughout and will lack the characteristic signs of coarctation. Rare congenital defects such as truncus arteriosus may show an anomalous course of the common vessel and it would then be impossible to outline the aorta and the pulmonary artery as separate vessels aris-



ing from the heart. Rib erosion would not be expected.

There are several criteria which might be used to differentiate the infantile type of coarctation from the adult type. In the infantile type, which occurs practically entirely in still-born or young infants, there is usually a diffuse narrowing of the aorta which extends for a considerable distance proximal to the patent ductus and therefore the defect differs in character and location; the pulmonary artery is much dilated and there is no collateral circulation.

#### SUMMARY

A review of the diagnostic features of coarctation reveals two findings which may be considered pathognomonic, a defect in continuity of the arch at the junction of the transverse and descending portions of the aortic arch outlined in the left posteroanterior oblique film, and rib erosions which may be identified in either the oblique or posteroanterior views. Rib erosion, when present, may be considered practically pathognomonic, in spite of the fact that the sign is of an indirect character, for it demonstrates the presence of a collateral circulation due to the obstruction. This is not noted in other conditions except under the rarest of circumstances, and in these rare cases rib erosion has not been described, probably because the process is too acute or rapidly progressive.

There are sufficient data in the literature to show, however, that the absence of rib erosion does not rule out a coarctation, for no collateral circulation may be present or, if present, it may not involve the intercostal arteries to a sufficient degree to produce erosion of bone. The demonstration of a characteristic defect in the arch in the oblique view becomes therefore the most reliable single finding in coarctation and can be demonstrated in all cases where it is possible to secure a satisfactory left oblique posteroanterior film.

The other common findings in coarcta-

tion are suggestive or corroborative only. The absence of the aortic knob in the usual posteroanterior film is highly significant in an adult and such a finding should lead to a complete cardiac study in which special emphasis should be placed on the appearance of the aortic arch in the left oblique posteroanterior view. It is quite probable that the presence of a definite aortic knob in the posteroanterior view is more conclusive evidence of the absence of coarctation than is its absence in ruling it out. A left ventricular hypertrophy and a dilatation of the proximal aorta, which are also usually present in these cases, are noted commonly in various other cardiovascular disorders. This evidence is suggestive or confirmatory only.

It will be noted from this study that the left posteroanterior oblique view of the chest is of greater importance than the usual posteroanterior view. It will actually yield more positive and definite information. Thus, four out of the five roentgenologic features, the defect in the arch, rib erosion (pathognomonic evidence), as well as the demonstration of left ventricular hypertrophy and dilated proximal aorta, can be determined in the oblique view, and of these four at least three are seen to better advantage or can be recognized with greater certainty in the oblique view: the defect in the arch, the left ventricular hypertrophy and the aortic dilatation. Absence of the aortic knob, the finding which is to be noted only in the posteroanterior and anteroposterior films finds its more reliable equivalent in the defect in the arch in the oblique film.

#### CONCLUSIONS

1. The roentgen findings in coarctation of the aorta (adult type) are sufficiently definite and characteristic to establish the diagnosis by this means alone.
2. A simple roentgen technique consisting of a roentgenoscopic examination, a posteroanterior film and a left postero-

anterior oblique film is sufficient to establish the diagnosis.

3. The direct roentgen signs of coarctation relate to the defect in the aortic arch in the posteroanterior and left anterior oblique views.

4. The indirect signs, left ventricular hypertrophy and dilatation of the ascending aorta, relate to the obstruction of the blood flow through the aorta and the rib erosion to the collateral circulation which results from such obstruction.

5. Of these findings, two are of the greatest importance, the direct sign of the defect in the arch and the indirect sign of rib erosion.

6. Two cases of coarctation are described which illustrate all the roentgenologic features necessary for the establishment of the diagnosis.\*

*Later Note.* Since completing this article, through the kindness of Dr. John T. King of Baltimore, we have had the opportunity to examine prints of films of 4 cases of coarctation, 3 of which Dr. King

\*The writer wishes to express his thanks to Dr. G. H. Whipple for permission to include his autopsy findings of one of the cases reported. To Dr. S. L. Warren he is greatly indebted for many helpful suggestions and aid in the preparation of the manuscript.

has reported as coarctations, the fourth case being one first diagnosed as coarctation by Dr. Milton B. Kirsh and subsequently seen by Dr. King. The films were of great interest to us in showing a cardiovascular shadow similar in type to those of our cases. Three out of the 4 cases show unmistakable evidence of rib erosion. Dr. Kirsh's case was particularly instructive since this one was followed during youth over a period of seven years by films (ages, period 10-17 years). Films obtained at ten and twelve years show no notching of the ribs, while at seventeen years notching has begun. Dr. King, in a personal communication, notes that the most marked erosion was in the oldest patient and the least in the youngest. This is in agreement with the impression we had gained that erosion of ribs is dependent in part on the length of time the condition has been present, i.e., the patient's age.

This suggests that rib erosion (like the absence of the aortic knob) is probably not a reliable sign in youth, and to establish the diagnosis roentgenologically main reliance must be placed on the direct sign of the defect in the arch in the left oblique view.

#### REFERENCES

1. ABBOTT, M. E. Coarctation of the aorta of the adult type. II. A statistical study and historical retrospect of 200 recorded cases with autopsy, of stenosis or obliteration of descending arch in subjects above the age of two years. *Am. Heart J.*, 1928, 3, 574-618.
2. ABBOTT, M. E. *Osler's Modern Medicine*, 1926.
3. BLACKFORD, L. M. Coarctation of the aorta. *Arch. Int. Med.*, 1928, 41, 702-735.
4. CRAGIE, D. Instance of obliteration of aorta beyond the arch, illustrated by similar cases. *Edinburgh Med. & Surg. J.*, 1841, 56, 427.
5. HAMILTON, W. F., and ABBOTT, M. E. Coarctation of aorta of adult type. *Am. Heart J.*, 1928, 3, 381-421.
6. HOLMES, G. W., and RUGGLES, H. E. *Roentgen Interpretation*. Lea and Febiger, Philadelphia, 1926.
7. KING, J. T. JR. Stenosis of the isthmus (coarctation) of the aorta and its diagnosis during life. *Arch. Int. Med.*, 1926, 38, 69-95; correction, 1926, 38, 409.
8. KING, J. T. JR. Clinical aspects of congenital anomalies of the aorta. *Am. Heart J.*, 1926, 2, 144-151.
9. KÖHLER, A. *Röntgenology*. Wm. Wood and Co., New York, 1929.
10. MACKENZIE, G. M. Coarctation of the aorta with *Staphylococcus albus* endocarditis. *Am. J. M. Sc.*, 1927, 174, 87-96.
11. PHILPOTT, N. W. Two cases of cardiovascular anomaly. *Ann. Int. Med.*, 1929, 2, 948-962.
12. POYNTON, F. J., and SHELDON, W. P. H. Coarctation of aorta with ulcerative aortitis. *Arch. Dis. Childhood*, 1928, 3, 191-193.
13. RAILSBACK, O. C., and DOCK, W. Erosion of ribs due to stenosis of the isthmus (coarctation) of the aorta. *Radiology*, 1929, 12, 58-61.
14. SALA, A. M., and NACHAMIE, I. Coarctation of the aorta. *Arch. Int. Med.*, 1929, 43, 420-424.
15. VAQUEZ, H., and BORDET, E. *The Heart and the Aorta*. Trans. by Honeij and Macy. Yale University Press, New Haven, 1920.

## AMNIOGRAPHY

### PRELIMINARY REPORT

By THOMAS O. MENEES, M.D., J. DUANE MILLER, M.D., and LELAND E. HOLLY, M.D.

*Blodgett Memorial Hospital*

GRAND RAPIDS, MICHIGAN

**O**BSTETRIC roentgenography has been limited almost entirely to a demonstration of the fetal bones and uterine contour. Occasionally, when the subcutaneous fat of the fetus is unusually thick, the outline of an extremity is obtained. The slight difference in density of fat and liquor amnii is sufficient to cast a shadow. This suggested an artificial increase in density of the amniotic fluid to give contrast to fetal soft parts and placenta. Amniography is proposed as a name for this procedure, differentiating it from uterography, the roentgenography of the non-pregnant uterus.

This contrast is obtained by the injection of a one to one solution of U.S.P.

strontium iodide through the anterior abdominal wall. The actual concentration is about 0.75 gm. per c.c., as strontium iodide contains six molecules of water of crystallization. After anesthetizing the skin with novocaine, a small flexible lumbar puncture needle is passed into the amniotic cavity, usually below the umbilicus and near the midline. The puncture is made on the side with the fetal small parts. After obtaining fluid through the needle, the injection is made slowly with frequent withdrawals of amniotic fluid to dilute the solution. Following injection, it is advisable to wait half an hour to an hour before taking the films, to permit an even diffusion throughout the amniotic

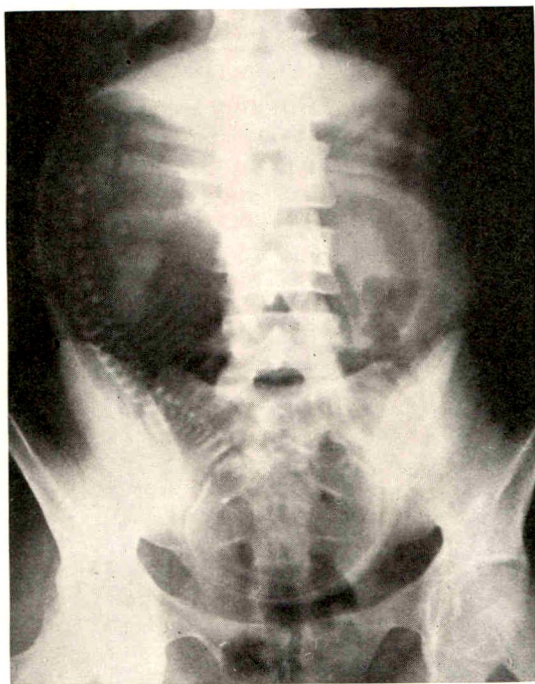


FIG. 1. Posteroanterior film and tracing showing the fetal small parts well outlined. Several loops of cord are visible. The breech shows no projecting shadow of scrotum, justifying a diagnosis of female fetus. The fetal stomach contains strontium iodide.



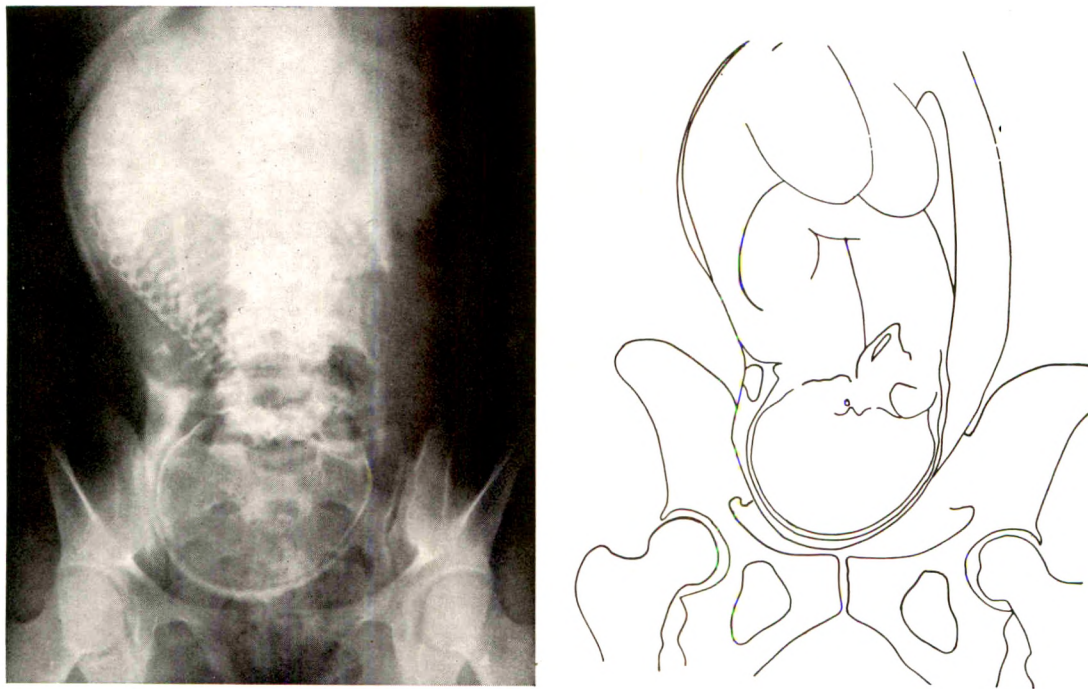


FIG. 2. Posteroanterior film and tracing showing a flattening of the left margin of the uterus, probably due to placenta. The cord is shown encircling the fetal neck.

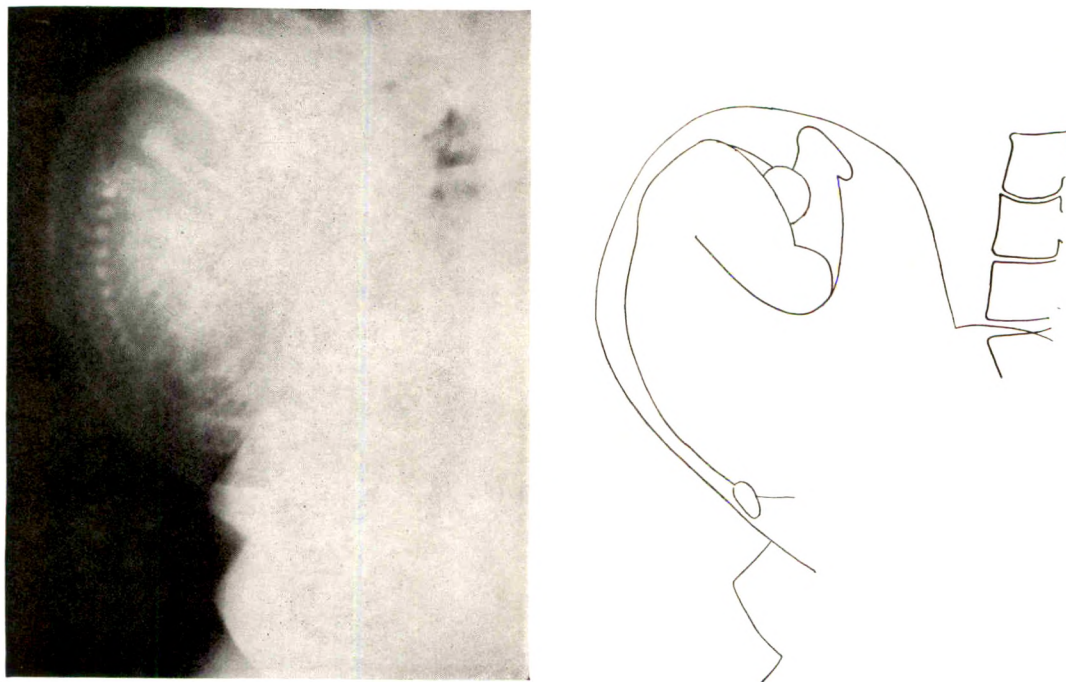


FIG. 3. Lateral film and tracing showing the breech well outlined. A rounded projection from this was interpreted as scrotum justifying a diagnosis of male fetus. The cord is shown about the fetal neck. •



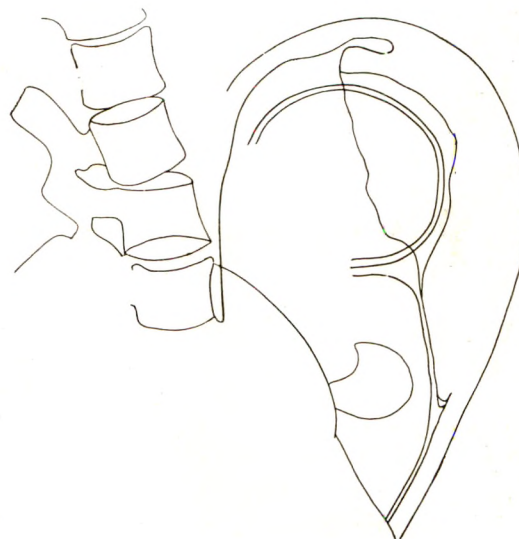


FIG. 4. Lateral film and tracing showing the placenta occupying the anterior portion of the fundus. The fetal stomach contains strontium iodide.

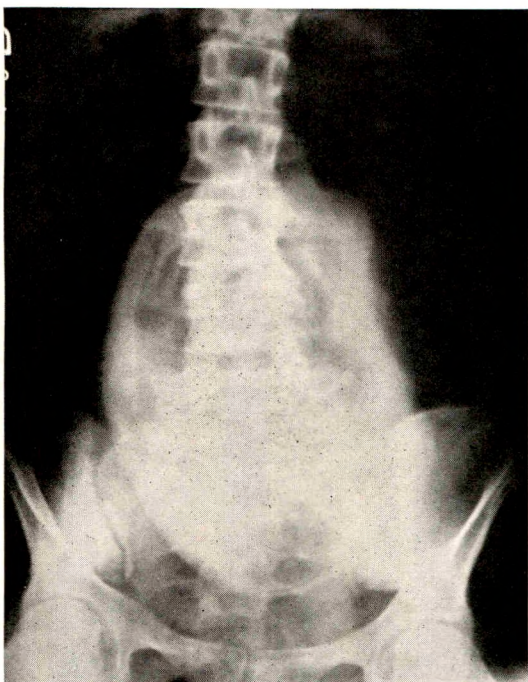


FIG. 5. Posteroanterior film and tracing showing a distinct outline of fetal small parts. The placenta extends backward to the left side of the uterus producing an irregularity in the amniotic contour.

cavity. During this time the patient changes position frequently to assist in the mixing. The exposures are made on a Potter-Bucky diaphragm, using a high milliamperage and relatively low voltage to insure a maximum contrast.

The correct amount of solution to inject is difficult to estimate. It varies with the quantity of liquor amnii present and this is almost impossible to determine in advance. If too much solution is injected, the whole interior of the uterus will become opaque and the object of the examination will be defeated. From 7.5 to 15 c.c. of the solution have been used. The larger amounts caused too much opacity and probably 9 or 10 c.c. will be sufficient for the average case in the latter months of pregnancy.

In the 21 cases injected there have been no injurious or toxic effects to the mother or fetus in normal pregnancies. In a case of placenta praevia, at the sixth month, the fetus was expelled about thirty hours after injection. The cord was pulsating and the fetus made a few feeble attempts at respiration. The placenta showed a partial separation. It was located low on the anterior wall and may have been perforated in the injection. The pulsating cord excluded any toxic effect to the fetus.

These films have shown the location of the placenta in the majority of cases. The placenta appeared as a filling defect or a flattened area, best seen when caught in profile. Probably the failures to show the

placenta were due to the fact that it was not projected in profile on the usual posteroanterior and lateral views. Under these circumstances oblique views are of help. The cord, encircling the fetal neck has been shown twice. Sex has been determined four times, three males and one female. A true lateral view of the breech is necessary for this, and this happens rather rarely.

A shadow in the region of the left costal margin of the fetus has been present on a large percentage of films. This has been interpreted as strontium solution in the fetal stomach, indicating that the swallowing of amniotic fluid must be of frequent occurrence.

The rate of absorption of strontium iodide was surprisingly rapid. Films taken four or five hours after injection showed an appreciable decrease in the density of the shadow. The fetal contours were lost at about twenty-four hours, showing that most of the salt had been absorbed by this time.\*

#### SUMMARY

A method is described for visualizing fetal soft parts, localizing the placenta, and occasionally determining sex. It may be of value in the diagnosis of placenta praevia and determining the exact relation of the placenta to the cervical canal.

\* We wish to acknowledge our indebtedness to Drs. Joe De Pree, A. M. Campbell, and J. D. Hastie for assistance and encouragement in this work.





# THE DIAGNOSIS OF EARLY ILEOCECAL TUBERCULOSIS

## A PRELIMINARY REPORT WITH SPECIAL REFERENCE TO THE DOUBLE CONTRAST ENEMA

By J. GERSHON-COHEN, M.D.

*Instructor in Roentgenology, Graduate School of Medicine, University of Pennsylvania;  
Roentgenologist to Eagleville Sanatorium, Eagleville, Pa.*

PHILADELPHIA, PENNSYLVANIA

THE diagnosis of early ileocecal tuberculosis is at present made by the roentgen examination alone, the time having passed when this disease could be diagnosed clinically only in the later stages and then invariably fatally prognosticated. The veracity of these claims have been amply developed by able workers in this field.

Stierlin,<sup>24</sup> in 1911, published an excellent article on the roentgen diagnosis of tuberculous ulceration of the colon and described many of the phenomena on which the modern interpretation is based. It was probably because he failed to call more commanding attention to the crucial diagnostic test, namely, hypermotility of the barium meal through the affected segment of colon, that the real significance of his work in the diagnosis of early colonic tuberculosis went so long generally unrecognized by such investigators as Case,<sup>7</sup> Bécélère and Mériel,<sup>3</sup> Kienböck,<sup>15</sup> Bandelier and Roepke,<sup>2</sup> Faulhaber,<sup>9</sup> Révész,<sup>19</sup> François,<sup>13</sup> Sigmund,<sup>23</sup> Carman,<sup>5</sup> Schlesinger,<sup>22</sup> Flemming Møller,<sup>12</sup> and others, all of whom could corroborate his findings in only a very limited number of cases or entirely disagreed with the diagnostic value of his findings. Pirie<sup>18</sup> called attention to this phase of the roentgen examination in 1915, but it remained for Brown and Sampson<sup>4</sup> to elaborate and convincingly demonstrate by the use of the barium meal, the accuracy and reliability of the roentgen examination in the diagnosis of early tuberculosis of the colon, by elaboration of Stierlin's phenomena. They have extensively and most thoroughly studied this subject and have developed an excellent technique of exami-

nation with the barium meal. They place great reliance on the opaque ingested meal method for filling the segments of the intestinal tract to be studied, making serial roentgenoscopic and roentgenographic examinations at regular intervals from the seventh to the tenth hour after the ingestion of the meal. The "filling defects" in

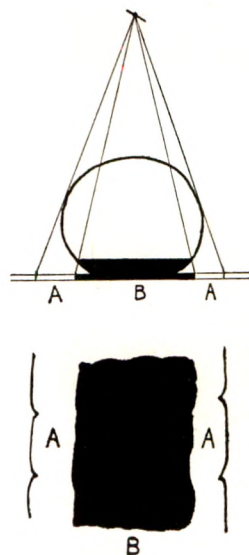


FIG. 1. Patient in supine recumbent position and the roentgen rays directed vertically. A. The upper layer of air is projected to the sides of B. Dependent layer of residual contents. In the roentgenograms, the intraluminal processes are thus visible in the projected column of air in the peripheral zones of the colon whose walls are coated with the opaque barium mixture. This position, although it affords visualization of smaller sectors of air-filled barium-coated colon, has been found most generally satisfactory because the entire length of the colon can be studied at once and necessitates but one exposure. The other supplementary positions, as shown in Figures 2 and 3 can be used when indicated.



the ascending colon which must be constant in all or most of the serial roentgenograms and which are due to spasm, irritability and hypermotility of the opaque

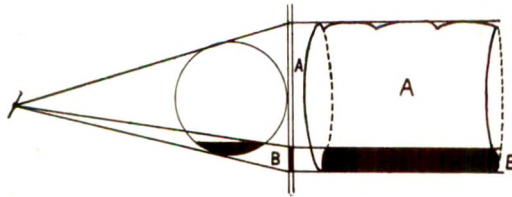


FIG. 2. Patient in lateral recumbent position—horizontally directed roentgen rays. Projection of large air sector of barium-coated bowel above dependent small sector of residual barium-containing bowel.

contents through the affected segments, are the signs carrying the greatest weight in the diagnosis. They fully describe the variations of these phenomena and stress these functional changes as being the only roentgen evidence in early tuberculosis of the colon. The enema study of the colon is believed by them, however, to be definitely less reliable in the demonstration of these phenomena. They regard spasm of the colon during the enema study as not necessarily unnatural and therefore not sufficiently diagnostic of pathological changes, and claim further that a segment of colon which cannot be filled with the ingested meal (resulting in "filling defects") is in an entirely different state from one which fills and contracts or "spasms" during the enema examination. Yet they believe spasm that is limited to the cecum, more significant and go on to say that with the enema when, as observed in tuberculous colitis, the cecum or ascending colon repeatedly fills and empties, this finding is of extreme importance. Examination of their tables also reveals the fact that in their cases which revealed positive evidence of tuberculosis of the colon with the barium meal, the enema also yielded positive findings in practically all of the cases studied by both methods. It seemed, therefore, that their investigations were unwarrantedly prejudiced against the use of the enema

examination which has many advantages over the barium meal technique. The enema examination can be done with greater dispatch, the patient need be brought to the roentgen department only once, it furnishes all the information obtainable with the barium meal and, in addition, eliminates very frequently the difficulty often encountered in the interpretation of the "filling defects" of the serial roentgenogram which are not true filling defects, but ever changing contours and irregular outlines of a segment of colon through which there is hypermotility, due to irritability, hyperperistalsis and spasm.

Realizing these advantages and the potential possibilities of the double contrast air-barium enema studies of Fischer,<sup>10</sup> we developed a technique of examination that has made possible an earlier and more reliable diagnosis of ileocecal tuberculosis than with the barium meal method. These studies were made on 138 cases of pulmonary tuberculosis at Eagleville Sanatorium, most of the patients coming from the service of Dr. A. J. Cohen, all having tubercle bacilli in the sputum and all patients examined clinically and especially for this analysis by Dr. Louis Cohen. Forty-two cases revealed positive evidence

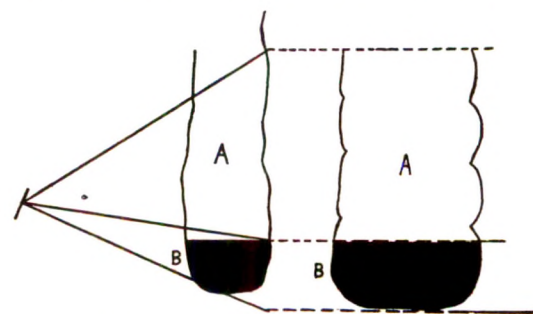


FIG. 3. With the patient in the erect position, the roentgen rays directed horizontally project the colonic outline with the air column above the dependent layer of residual contents. A. Air in barium-coated colon alone. B. Residual column of barium. This position is best in studying those portions of the colon that take a transverse direction, namely, the transverse colon, portions of the sigmoid and redundant parts of the ascending and descending colon.



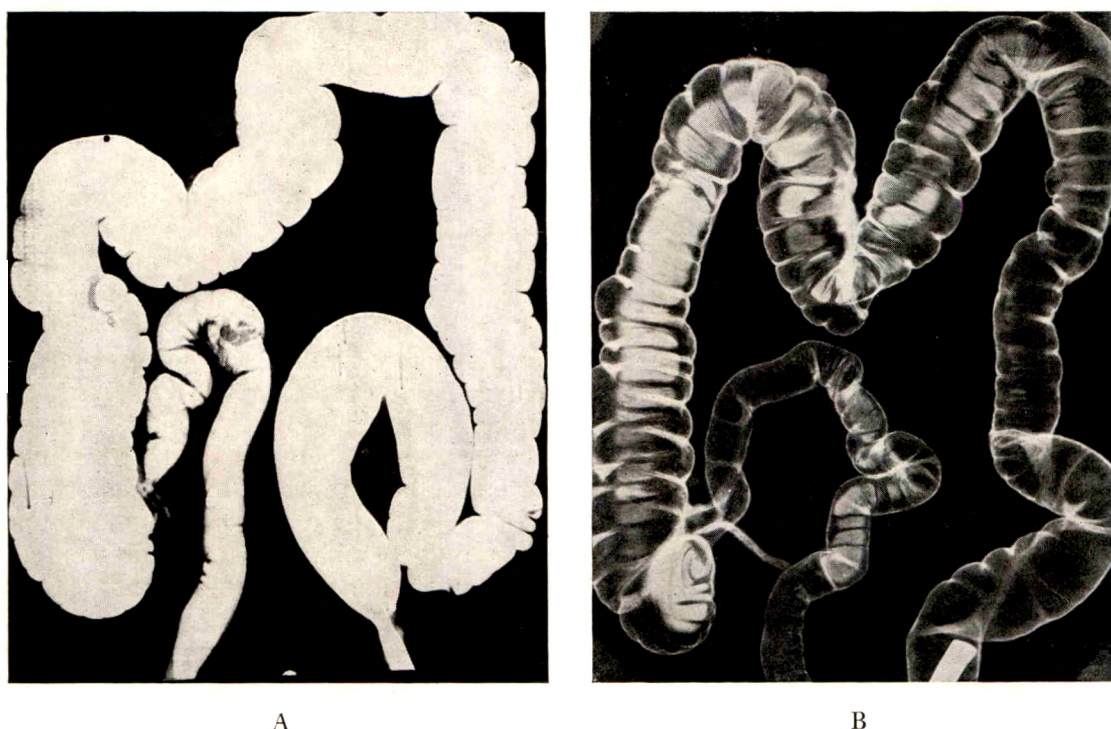


FIG. 4. A. Single contrast enema. B. Double contrast enema. Note in the double contrast enema how clearly and easily the intraluminal surfaces and haustral markings are seen throughout the entire length of the colon. The colon, which has been removed from the cadaver, has been placed flat on the table and the roentgen rays directed vertically so that the air column has been projected to either side of the residual, centrally dependent barium contents.

of ileocecal tuberculosis. Thirty-one cases also had routine roentgenographic studies of the entire gastrointestinal tract incorporating the Brown-Sampson technique of colonic examination. These cases were thus studied not only to check the findings as revealed by enema examinations, but to study what diagnostic advantages whether complementary or supplementary, one method had as compared to the other. Dr. Harry Shay also made thorough clinical and laboratory gastroenterologic studies on this group. Sixteen cases of this smaller group were found to have ileocecal tuberculosis, one in the first stage, 6 in the second stage and 9 in the third stage. The diagnosis was suspected clinically in 7 of these cases, but in all of these 16 cases Dr. Shay made a constant finding in the microscopic examination of the feces, which he is reporting elsewhere. Both the barium

meal and enema studies revealed positive evidence of ileocecal tuberculosis in these 16 cases, but of those studied by the enema method alone, 26 additional cases were positive. The evidence furnished by the enema studies gave us a better concept of the extent and intensity of the infection than did the barium meal serialographic examinations, but the latter, nevertheless, yielded useful confirmatory evidence. A statistical analysis is not included here since these combined studies are still being pursued at Eagleville, and this report is intended to set forth only the technique and exposition of the value of the "double contrast colographic" studies of ileocecal tuberculosis.

#### TECHNIQUE

Without special preparation, an opaque mixture, such as is generally in common



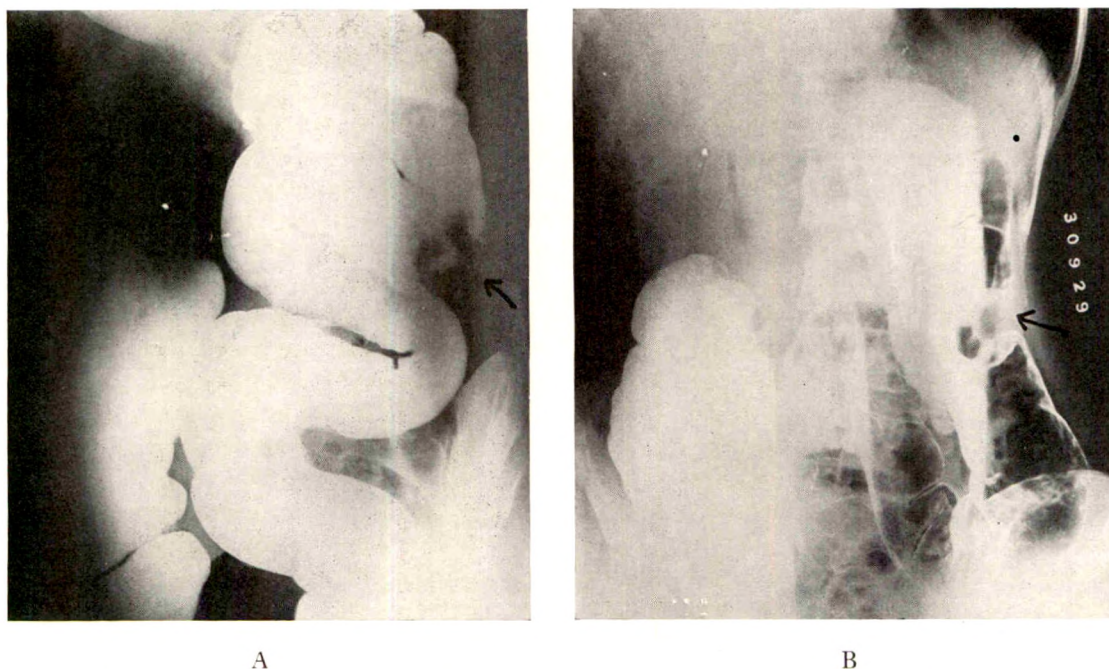


FIG. 5. Small adenocarcinoma of descending colon almost completely obscured in single contrast enema examination. A. Even though patient has been rotated to show defect best. B. The tumor is very clearly demonstrable in double contrast enema roentgenograms, with patient in the right lateral recumbent position, roentgen rays horizontally directed. (Diagnosis confirmed at operation and histological examination, from the service of Drs. H. L. Bockus and William Bates, at the Graduate Hospital, Philadelphia.)

use, is first injected into the colon under roentgenoscopic control and the usual observations made, paying special attention to spasm and irritability of the colon, particularly on the right side, mass peristalsis, anastalsis, competency of the ileocecal valve, the outline of the colon, ileocecal valve and terminal ileum, the presence or absence of pain and tenderness over any segment of colon, the distribution, form, balancing and the peristaltic changes of the haustra, the mobility of the cecum and ascending colon and the constancy of any irregularities or defects in the colonic outline. A roentgenographic examination is then made and the patient permitted to evacuate the opaque contents. This is followed by another *intermediary roentgenoscopic examination* at which time the distribution of the residual contents is carefully noted. Mass peristalsis of a residual column in any colonic segment is looked for at this time, either that which may occur

spontaneously or after palpation. Air is then inflated into the colon using a Pulitzer bag with a ball-valve, the bag being attached to an 18 inch length of rubber tubing and held above the level of the abdomen. This is done slowly under roentgenoscopic control and is stopped when the colon is filled. No pain is experienced by the patient if this is done slowly. The roentgenoscopic examination, as with the single contrast, enema, is again made and is followed by roentgenographic studies with the patient in the supine position and the roentgen rays directed vertically (Figs. 1 to 5).

#### THE DOUBLE CONTRAST ENEMA ROENTGENOGRAMS

The difference in shadow densities in a roentgenogram form the real basis for roentgen diagnosis, and the inflation of air into canals or hollow viscera in order to supply a good contrast medium is not a

new procedure. This idea is now commonly employed in ventriculography and encephalography, one of the greatest recent advances in the roentgen diagnosis of brain lesions. The same idea was employed long ago by Cole and Einhorn,<sup>8</sup> Pfahler<sup>16,17</sup> Schittenhelm,<sup>21</sup> Röpke,<sup>20</sup> and others, when they inflated air into the colon to outline intraabdominal tumors, the lower border of the liver and spleen, or air into the bladder to more clearly demonstrate intravesical growths, or when they inflated air into the stomach either with the tube or by the use of effervescent powders to reveal its outline and intraluminal contents. These latter procedures were definite steps forward, but their routine use has been abandoned probably because insufficient contrast of densities was obtained, resulting in difficulties of interpretation due to overlapping of the air-filled coils of colon and ileum and the indistinctness in outline of many of the air-inflated segments. The double contrast air barium roentgenograms of the colon, however, make the utmost use of differences in medium densities; that is, air against the barium-coated colonic mucosa. This strong contrast of densities naturally leads to greater accuracy in the visualization of pathological processes, the coating on the air-containing walls making them stand out in more marked contrast. Intraluminal lesions then become visible which otherwise would be hidden and obscured in the single contrast medium, and the entire length of the colon can be traced no matter how much overlapping, redundancy and reduplication there may be.

The double contrast enema serves other useful purposes in the study of ileocecal tuberculosis. It becomes a check on the findings of the single contrast enema. Thus, irregularities in outline or defects in contour due to spasm, incomplete filling with the single contrast medium or retained fecal material, being absent in the double contrast roentgenograms, no longer confuse the interpretation. If the same irregularities of outline, however, are seen in both

the single and double contrast roentgenograms, then their true significance may become immediately manifest; but in the double contrast films a better concept of the nature and extent of the pathological change is obtained because of the greater and clearer visibility resulting from the more marked contrast between the barium-coated mucosa and the enveloped air.

When we first began using these double media, we were so impressed with the many new fine details of structure that were visible, that we thought this method might even be used to demonstrate the small early tuberculous ulcer itself. Various changes in the constituents of the opaque mixture were made by the addition of acacia, tragacanth, olive oil, glycerin, various pastes of flour, etc., with the hope that a selective adherence to the ulcerated margin or surface would follow with a greater residual deposit on the lesion than on the normal surrounding mucosa. We found, however, that there was practically no difference in any of these mixtures, even when we used tuberculous colons removed from the cadaver for this experimentation. Although ulcers could be seen in the double contrast films of these excised colons because of the slightly greater accumulation of barium suspension on and under the margins and over the necrotic surface of the ulcer, we were never able to see them, except in occasional instances, in the roentgenograms of patients with colonic tuberculosis. This, of course, is due to the secondary radiation from the surrounding tissues which is just sufficient in most instances to obscure these fine linear deposits.

Many additional details of the lesions in both the ulcerative and hyperplastic types of colonic tuberculosis are visible in the double contrast roentgenograms that are completely absent in the single contrast films and not even suggested in the serialograms with the barium meal. Hyperplastic ulcers with small, fine, irregular lakes of residual barium in their interstices, fine and coarse contracting fibrous bands, the

ulcerated margins of the ileocecal orifice with the attendant changes in its size and shape, excessive mucus with its impregnated barium sharply visible in its flaky or stringy distribution in the colonic air column, necrosing sloughs, clinging with their streaky irregular deposits of barium to the colonic walls, are some of the many fine details that can be seen only in the double contrast films, making possible a more accurate interpretation of the type, extent and severity of the tuberculous process.

Our diagnosis therefore of early ileocecal tuberculosis is no longer limited to the major phenomenon of splitting of the barium meal column by and through the affected segment resulting in "filling defects" often defying correct interpretation and furnishing us with misleading concepts concerning the anatomico-pathologic changes. The single contrast enema completely fills the colon and since this must first be done in order to complete the double contrast study, the findings of one can be checked against those of the other. The intermediary examination between the enema studies is also used for checking the phenomena of motility, spasm and mass peristalsis, and proves of inestimable value in the diagnosis of early ileocecal tuberculosis when these functional phenomena are the only signs obtainable. With all these new roentgen signs thus available, we believe that the different stages of the tuberculous processes are definitely demonstrable by characteristic roentgen signs and so we have classified them into three stages.

#### PATHOLOGY

Tuberculosis of the intestinal tract may be acute or chronic and run a short fulminating or a long drawn out course. The infection may be limited to the small bowel, usually the ileum, or to the cecum, or ileocecal region or extend through the ileum, jejunum and colon, even to the rectum. The infection may be very limited or

scattered widely in isolated areas or involve almost uniformly long segments of the terminal ileum and cecocolon. It is, therefore, like pulmonary tuberculosis, in that it also has a favorite site of initial infection and variations in its characteristics resulting from differences in the quantitative degrees of infection, extent of involvement and types of tissue reactions, all of these factors entering into the different classifications of the disease.

The favorite site for tuberculosis of the intestinal tract in the adult is the terminal ileum; next the cecum, and with decreasing frequency from these locations, into the jejunum and distally into the transverse and descending colon. Tubercles first develop either in very limited numbers or in greater abundance in Peyer's patches or in the lymphoid collections in the cecum. These areas are the commonest initial sites of infection because the ingesta after passing rapidly through the jejunum is delayed again for a longer time in this region. This retention in the ileocecal area, whether it be for the completion of digestion or for certain processes of assimilation, or for both, allows contact of the mucosa with the infective ingested contents for a longer period than elsewhere in the intestinal tract and thus accounts for this localization of the process in the greatest majority of cases. Nonspecific enterocolitis, frequently complicating pulmonary tuberculosis, the result of forced feeding with high caloric diets, often not ideally balanced and changed, with enforced rest and insufficient exercise, is also probably a contributing cause for this characteristic localization of the infection. Thus the combined unfortunate circumstances of a mildly inflamed intestinal tract with continued or repeated exposure to infective ingesta, are all too frequently seen in active cases of pulmonary tuberculosis.

In the first or earliest stage, tubercles will form, possibly simultaneously over a wide area or first in one localized region and later in other distant segments. In the



beginning, they may be miliary or larger in size and form gray, projecting, translucent nodules of different sizes. The mucous membrane over such nodules is often reddened, turgid and injected. Accompanying the purely proliferative reaction to the tubercle bacillus (as seen histologically), is a low grade inflammation consisting of some transudation of serum and a few red and white blood cells. Inspissation or even calcification may ensue at this phase, but what is more usual, necrosis of the mucous membrane over the apices of the nodules follows, forming crater-like superficial ulcers, from which a discharge of yellow, caseous, or greenish tuberculous matter may take place. Necrosis of the entire mucous membrane for a considerable distance on each side of the erupted caseous focus usually takes place. The edges of these ulcers are flaccid and undermined. About this time also, inflammatory edema of the nerve sheaths, as well as perineural and periganglionic round cell infiltration is seen.<sup>1</sup> Whether these changes in Auerbach's plexus are the sole cause of the increased tone and peristalsis of the affected segments or whether the catarrhal inflammation over wide areas of the mucosa, often concurrent with tuberculous infection, also plays a contributing part, has not yet been definitely determined. Under favorable conditions of natural resistance and with institution of the proper modern therapeutic measures, this initial stage may go no further, the healing processes arresting the progress of the disease.

The second or moderately advanced stage begins when these small isolated ulcers and nodules further spread and break down. The small ulcers may grow larger and coalesce with other nearby ulcers, forming thickened, infiltrated, everted, gnawed or undermined edges with their bases limited by a granulating or caseous submucosa or muscularis. These ulcers may extend widely and superficially in all

directions or they may extend deeply into the muscularis with the formation of tuberculous granulations around the edges and a gelatinous layer of caseous matter on the surface of the ulcer itself. Lymphatic extension is now more marked and nodules may form, often in great numbers, about the periphery of these ulcers, new tuberculous foci thus springing up nearby.

The third or advanced stage is ushered in with the further spread of these ulcerative processes, extending over wide areas from the ileocecal region back into the jejunum and forward into the distal portions of the colon. The ulceration may still remain superficial, with extensive uniform fibrosis in the submucosa and muscularis having progressed steadily forward. Extensive areas of slough and even false diphtheritic membranes may form. The walls of the ileum and cecocolon become smooth and rigid with rather uniform contraction of the lumen. On the other hand, the deep ulcers which showed less tendency to superficial extension, may excite very considerable and localized hyperplasia of fibrous tissues, forming irregular, jagged, projecting tumefactions of granulating hyperplastic tissue, occluding the lumen. Many remissions and exacerbations take place in the progress of the disease during the second and third stages of the disease and may even result in healing, on the one hand, or otherwise go on to a fatal termination.

All these pathological changes can be demonstrated by roentgen signs revealed in the enema studies as we have applied them. Although the tubercle and the first and earliest tuberculous ulcers themselves cannot be demonstrated, except in rare instances, yet their presence is indicated by the functional changes of increased tone, spasm, hyperperistalsis and hypermotility, excess exudation, etc., which the affected segments display during the different phases of the enema studies.

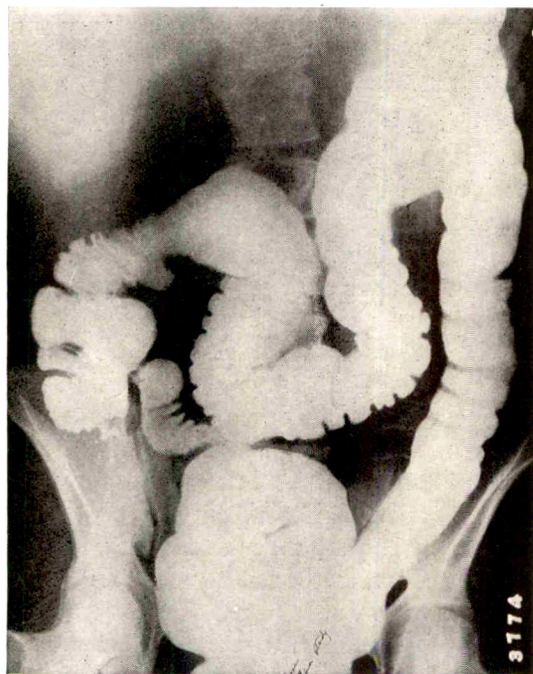


FIG. 6A. Spasm of cecum and upper ascending colon in single contrast enema.

#### ROENTGEN SIGNS

##### *Stage I. Earliest Phases.*

1. *Spasm.* Temporary tonic spasm, too long delayed, or intermittent spastic contraction occurring too frequently, is probably one of the earliest manifestations of irritability, associated with inflammation of an affected segment of colon. Colonic spasm of a segment of ascending colon naturally is more significant than in the more distal segments, since tuberculosis affects this side in the greatest majority of cases. Tonic contraction of the cecocolon may already be present before the head of the injected column reaches it, thus preventing its entrance. Spastic contraction of the cecum may follow only after it has been almost filled and then be followed by tonic spasm in other segments of the ascending colon. These spasms may be of short duration, but the periods of relaxation followed by complete filling, will often be shorter. At times, the spasms may be so tonic as to persist during almost the entire

examination. On the other hand, it may be so latent that it is only seen after palpation or after evacuation during the intermediary or double contrast air insufflation examinations. Spasm may be seen in only one of the enema examinations, but this is rare and when it occurs without other signs should be guardedly interpreted since extra colonic lesions, like subhepatic, perirenal or pericecal abscesses, or appendicitis, may cause similar spasm. Much care must also be exercised to differentiate spasm from incomplete filling due to insufficient opaque medium or air injection, from retained adherent fecal material and from true organic filling defects. This difficulty is seldom encountered since the three phases of the enema examinations afford checks on findings obtained during any one. Spasm is seen as a constantly changing, irregular outline of a contracted segment, with fine or coarse fibrillation of the haustra. If the



FIG. 6B. Spasm of entire ascending colon in double contrast enema. (Patient, female, aged thirty-two, early fibrocaceous pulmonary tuberculosis, tubercle bacilli in sputum, early ileocecal tuberculosis found at operation.)



roentgenograms were superimposed, the irregularity in contour could not be made to coincide, even though localized in the same segment. Spasm may not always be localized to the same segment in all the films, although it is usually confined to the right colon or the proximal half of the transverse colon in cecocolonic tuberculosis. Spasm in the distal segments of the colon may also be present, but is not regarded as significant during this stage of the disease (Fig. 6).

2. *Hyperperistalsis and Mass Hypermotility.* Peristalsis in the colon is accomplished by the disappearance of the haustra and contraction of the walls in progressive sequence of band-like segments. The irregular outline of the contained mass disappears, assuming a smooth elongated contour, like a blunt end sausage, and is then passed rather rapidly through the colon for a distance of 10 to 12 inches, or more, before coming to rest. Whether

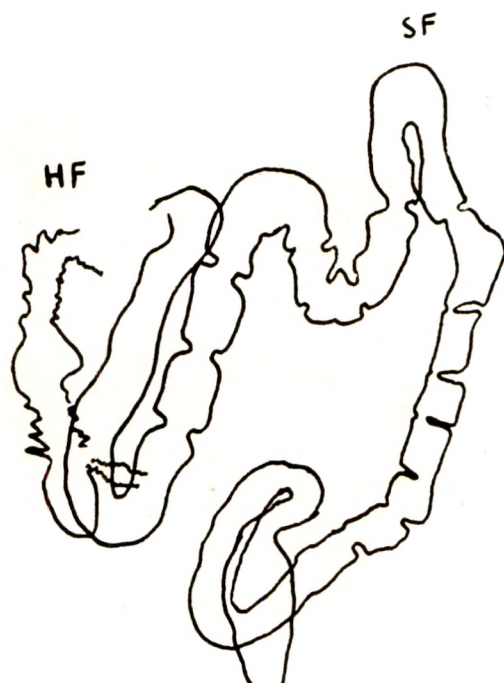


FIG. 6c. Diagrammatic drawing of double contrast films to illustrate salient details of outline that are necessarily lost in reproduction. HF. Hepatic flexure. SF. Splenic flexure.

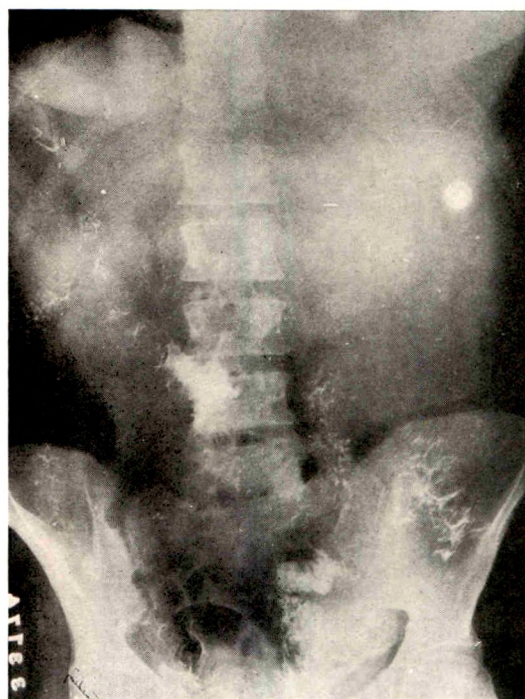


FIG. 7. The small residual column of barium contents seen in the mid transverse colon in this film made during the intermediary period of the enema examinations was first seen as retention in the cecum after evacuation. Slight palpation over the cecum was followed by mass peristalsis and this residual column was then seen to move continuously, except for repeated momentary hesitation, from the cecum to this position in the transverse colon before coming to rest.

anastalsis or reverse peristalsis in the ascending colon is normal in man is yet to be confirmed. Though haustra undoubtedly change in size and shape as another mechanism of peristalsis without mass motility, this also is very difficult to follow roentgenoscopically and necessitates serial roentgenographic examinations with superimposed tracings, to record graphically. Mass peristalsis has been seen by many observers, but not frequently by any one. It probably occurs only at long intervals and as Hurst suggests, chiefly after eating or with urgency just prior to defecation. The rare roentgenoscopic observations of mass peristalsis in the right colon applies equally whether the colon is normal or pathological when studied with the in-



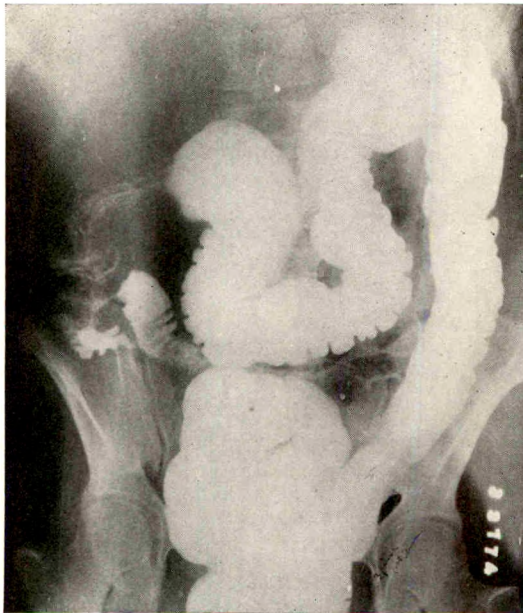


FIG. 8. Right colon almost completely evacuated by mass peristalsis. This patient was operated on and the appendix removed and found normal, but the cecum was also opened and inspected. A small tuberculous ulcer was found in the midst of several small scattered tuberculous nodules. She had incipient but open pulmonary tuberculosis. Resection of the ileocecal region was not done but patient has been placed on intravenous calcium and helio therapy.

gested barium meal. This is because in the presence of a pathological process the contents are resting in normal unirritated segments, already having been passed rapidly through those portions that are inflamed before the roentgenoscopic examination is made. But with the injected filling of the colon, *mucosal inflammation* with the concomitant *irritability of the nervous mechanism* seems certainly to be the cause for the frequency with which mass peristalsis is seen in the ascending colon, especially in the earliest stages of tuberculosis. One sees this mass hyperperistalsis not only during the injection of the opaque enema, but also during the intermediary examination and after the insufflation of air (see Fig. 7). If mass hyperperistalsis is missed during the opaque enema study, its presence may be indicated

by the complete evacuation of the material from the diseased segment when the double contrast enema studies are made. When this is seen and is confined only to the same segment, then the site of the diseased processes can be reliably localized. In certain phases of the earliest stages of colonic tuberculosis, where the allergic reactions to the disease are minimum or absent and mucosal inflammation and irritability of the nerve plexuses are quite limited, mass hyperperistalsis in the affected segment may be elicited only after more or less vigorous palpation. Sometimes not even palpation will call forth this reaction until tried during the intermediary examination or after the air insufflation. Then palpation over a residual column of material, if it be in the diseased area of the colon, will suddenly result in mass peristalsis usually ending some distance beyond the diseased segment (Fig. 8).

3. *Anastalsis*. In the positive cases of this series, anastalsis was frequently observed; that is, refilling of the emptied segment by reverse flow of the opaque contents from the next distal segment, when the injection of the opaque material is discontinued. In the normal, after the injecta is propelled out of the diseased area, it more commonly never flows back again unless the injection of either the opaque material or air is continued or its pressure increased. Anastalsis is supposed to be normal in the healthy ascending colon, but has rarely been recorded in the normal, and so its frequent occurrence in the earliest stages of colonic tuberculosis (with observance of proper precautions in the injection technique) becomes duly significant.

It is true that the serial roentgenograms made from the seventh to the tenth hour after the ingested meal also reveal hypermotility through the affected segment of cecocolon in this stage. The "filling defects," however, which may be present in all the films of any one serial study are often difficult to interpret. They are not true filling defects which can be superim-



posed in all the films nor are they marked enough always to be sure that they are relatively emptied segments, and so doubtful interpretations naturally result in those cases where these variations occur, especially if, in addition, they are not exactly limited to the same segment in all the films. These doubtful cases thus examined were often confirmed only by revelation of hypermotility and hyperperistalsis with the enema examinations. But the enema studies, moreover, are also self-sufficient in that they afford roentgenoscopic visualization of these functional changes, the intermediary and double contrast examinations serving as checks on the single contrast enema findings. These examinations always furnish more definite and convincing evidence of these early functional changes in ileocecal tuberculosis than the barium meal serial roentgenographic method and are easier to employ, cause less strain on the sick patient and can be done with greater dispatch.

4. *Hypersecretion.* This phenomenon is a common finding, *seen only in the double contrast films.* This term may not explain the cause since it may not be actually hypersecretion from the irritated mucosal cells that is the underlying cause for this condition. It is more likely excessive inflammatory exudation and only partly hypersecretion of neurogenic origin that results in the uneven adherence of the barium suspension to the colonic mucosa as viewed in the double contrast films. After evacuation, the residual coating of barium which usually clings to the normal mucosa, seems to have been flushed or washed away by the excess diluent products of exudation and secretion in the diseased areas. While the normal mucosa thus seems to have retained a smooth uniform coating of barium in the double contrast films, the inflamed areas appear as if they had no coating at all; as if the opaque injecta had never even coated these segments. This appearance, however, may be associated only with the most acute forms of mucosal

inflammation. In the more chronic varieties, the residual deposits of barium suspension assume different distributions. There may be irregularly defined localized areas of uncoated mucosa dispersed isolatedly in a segment, otherwise evenly coated; or there may be a more mucous, thready, criss-cross, checkered network of barium residue over the surface of the segment. If a catarrhal inflammation with excess mucus is present, which is a condition that it sometimes associated with ileocecal tuberculosis, having been possibly a contributing factor, one may then see a long sinuous thin or broad band of barium-impregnated mucus coursing through the column of air in the ascending colon whose walls are only faintly delimited, the opaque coating apparently having been washed away. The barium mucous residues may at other times be flaky and adhere to the

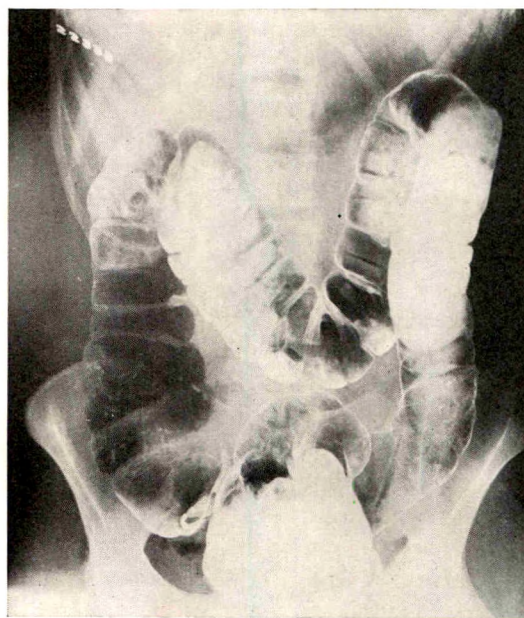


FIG. 9. Residual barium coating on mucosa of ascending colon appears almost completely washed away in most places while it is even, smoothly and uniformly adherent to the mucosa in the transverse and descending segments. Note absence of any defects of contour. (Female, aged twenty-nine, pulmonary tuberculosis, early fibrocaseous, grade 1, cecal tuberculosis, confirmed at operation.)

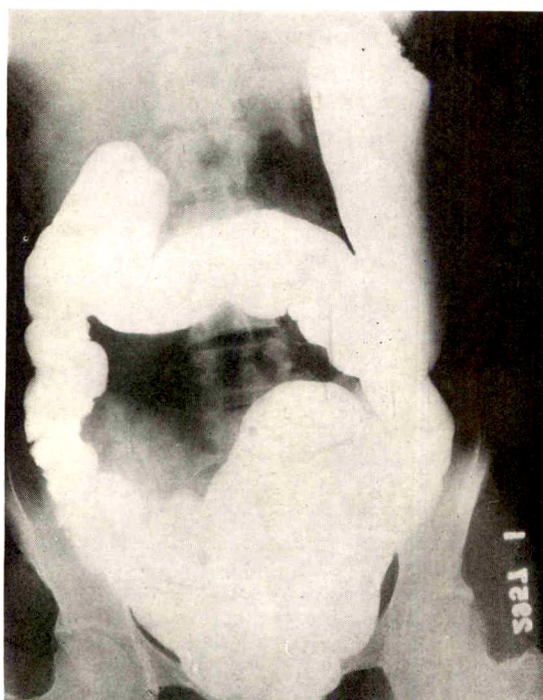


walls like plaques, irregularly outlined and distributed (Fig. 9).

5. *Pain and Tenderness.* Pain and tenderness were almost constantly found on palpation over the cecum or cecocolon in all the positive cases. Carnett's phenomena<sup>6</sup> occurring in cases of intercostal neuralgia were sought for in each case, using his recommended technique of examination. Only when this examination was negative and definite pain and tenderness were elicited by proper palpation over the affected segment, were we satisfied with the presence of these signs. Spasm, hyperperistalsis and hypermotility were often inaugurated with palpation, and cramp-like colicky pains ensued, of which the patient complains. We have repeatedly failed to elicit pain over the segment at the very beginning of palpation, but as soon as spasm and active motility started, the patient would complain of pain. The finding of pain over the cecum or cecocolon

would occasionally be forthcoming when the head of the column of barium or air injecta would enter the affected segment, even before palpation was done. Many patients have pain or a sense of soreness or discomfort over the entire abdomen which comes on after the examinations and lasts for a few hours after these examinations. We were disturbed by this during the earlier studies because we feared some possible delayed complications, but after many normal cases were also studied in which this finding was present, the unimportance of its presence in early cases (as well as late in the disease) was then recognized. Sharp localization of pain to a small segment of the cecocolon is rarely found, the cecum or a larger segment, if not the entire length of the cecocolon, being more or less affected.

6. *Incompetency of the Ileocecal Valve.* This is found in almost every case of early tuberculosis, but since some claim that this may occur normally in a high percentage of



A



B

FIG. 10A-B. Shortened contracted cecum. Note absence of barium coating of cecum in double contrast films.



cases, its value in this stage of the disease is possibly limited. But the filling of the terminal ileum, with partial or complete evacuation of the cecum or a portion of the cecocolon due to mass hyperperistalsis into the transverse colon, is an appearance that is seen in practically every positive case, whether in only one or more of the enema examinations. This appearance is the *analogue of the Stierlin phenomenon* (see Fig. 8) seen with the ingested meal, only that its formation is actually witnessed during the roentgenoscopic examination and its confirmation obtained in films made in a short interval of time with little inconvenience to patient or examiner.

#### *Stage II. Moderately Advanced Cases*

In the moderately advanced stage, not only may the phenomenon of the first stage be seen, but many additional signs become manifest. The anatomico-pathological changes are now such that they produce definite permanent roentgen defects and irregularities in the contours and outline of the terminal ileum, ileocecal valve and cecocolon, and are easily discernible. No longer must reliance be placed on functional changes alone of hypermotility, hyperperistalsis, irritability with spasm, pain and tenderness, in arriving at a diagnosis.

The disease is now well engrafted and

the earlier lesions have progressed, the healing processes having lagged behind. Although fresh lesions may have cropped up elsewhere in a particular segment, it is

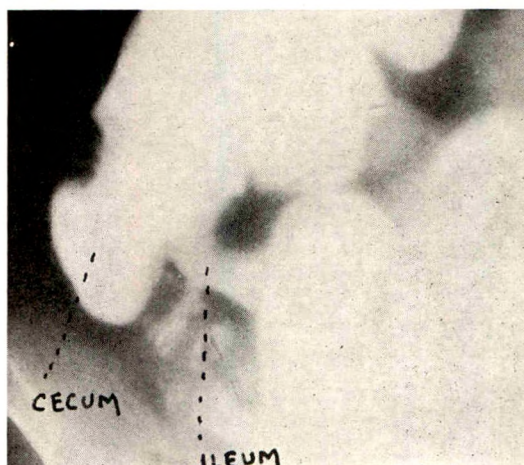
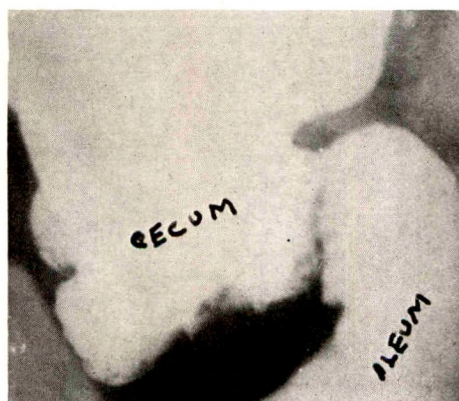
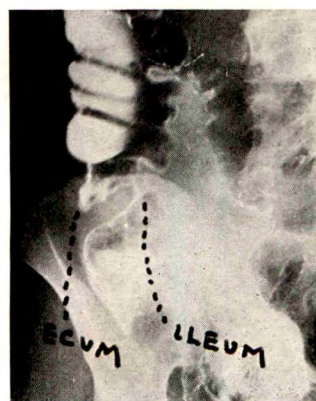


FIG. 10c. Tuberculous involvement causing fetal type contraction of cecum.

the older, more advanced processes that now produce the permanent changes that are roentgenologically discernible in the combined contrast films. Since the ileocecal region is the favorite site of these lesions, it is here that the first permanent changes are roentgenographically demonstrable. The deformities are most marked in the immediate ileocecal region, to either side of the ileocecal valve, in the terminal ileum and cecum and then less pronounced



D



E

\*FIG. 10D-E. Shortened, contracted, distorted cecum as shown by single and double contrast enemas.



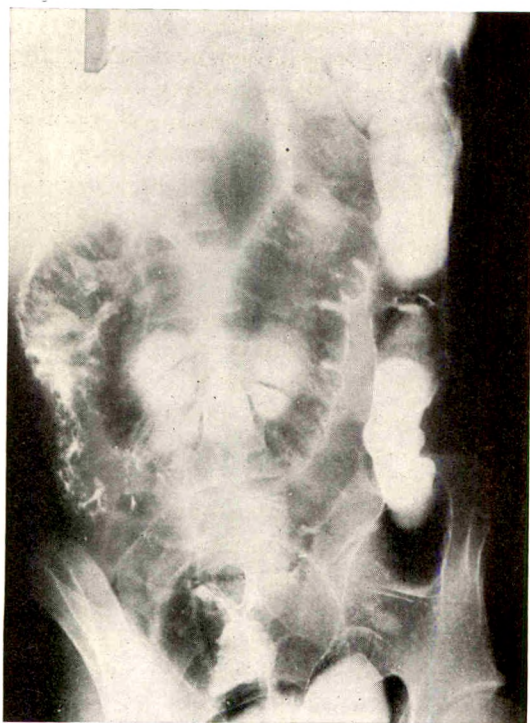


FIG. 11. Permanent filling defects most marked in cecum, gradually becoming less in the ascending colon towards the hepatic flexure.

toward the more proximal portion of the ileum and the more distal portions of the cecocolon.

### 1. *Irregularities and Filling Defects*

a. In the cecum constant irregularities in its outline are seen, sometimes localized as when due to isolated deep hyperplastic ulcers, or more generalized as when due to more extensive superficial ulceration. Often the margins of the cecum has a crenated or fibrillated outline due to the spastic contraction associated with the ulceration. This appearance sometimes seems to be due to incomplete filling of the cecum, but this is ruled out by repetition of this appearance in the double contrast films. When the ulceration has called forth a more extensive fibrosis in the walls of the cecum, it may contract more uniformly and assume the fetal type. Occasionally, the lumen will be only irregularly contracted or shortened. Instead of appearing as the segment

of the colon with the greatest intraluminal dimensions, as it really is, the caliber of its lumen is diminished to less than that of even the descending colon. These irregularities and defects in its outline and contour are permanent and are visible in the films of all the enema studies, the outlines in any particular case depending on the amount of fibrosis, ulceration, hyperplasia and spasm that may be present. Some of these changes are most strikingly seen in the double contrast films, since one can study not only the margins of the colon but also its intraluminal surface (see Fig. 10). In the early stages of tuberculosis, the right colon is invariably evacuated after defecation, with more or less complete flushing of the barium coating from the mucosa, but in this stage, irregularly outlined pools or lakes of residual contents are seen in the double contrast films either between the distorted, contracted areas of involved colon, or in the craters or under the excavated margins of the ulcers themselves. Adherent necrotic sloughs often give a bizarre trabeculated appearance to the coating of residual barium (Fig. 10).

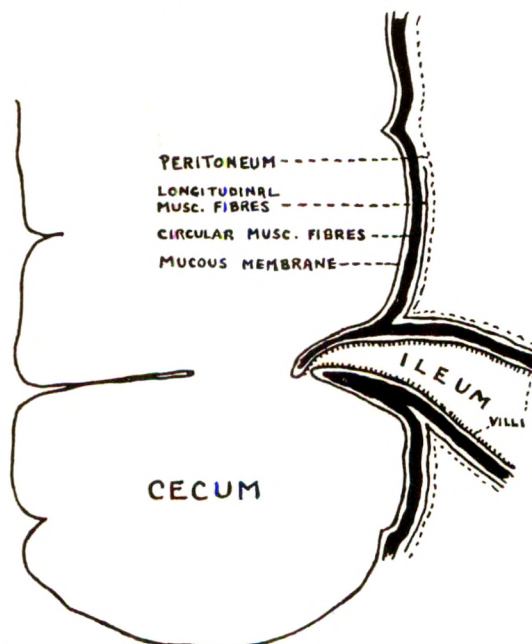


FIG. 12. Diagrammatic anatomical drawing of ileocecal valve.



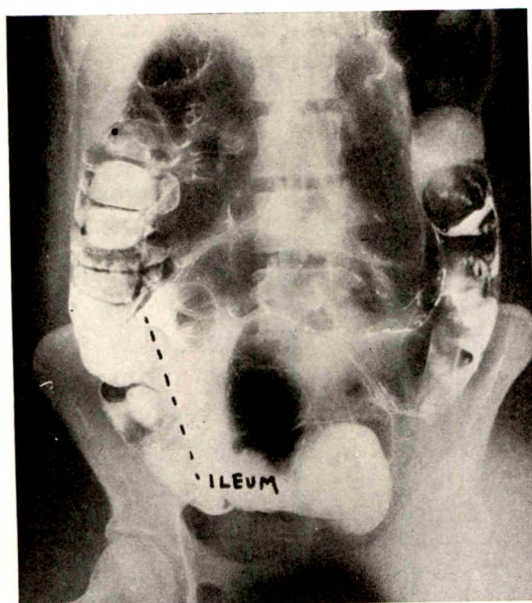


FIG. 13A. Profile view of ileocecal valve as seen in double contrast enema.

*b.* In the ileum, irregularities in its outline are seen similar to those in the cecum. Because of the incomplete filling, however, of the terminal ileum with both the opaque and air media, and the corrugation of its walls by the valvulae conniventes producing normally a serrated appearance to its margins, difficulty is met with in the interpretations of superimposed irregularities. Their constancy in both the single and double contrast roentgenograms, however, often helps in this differentiation.

*c.* In the ascending colon above the cecum, changes described as occurring in the cecum are also seen, but less marked, especially as the hepatic flexure is approached (Fig. 11).

2. *Fleischner's Sign.* This is a valuable sign in this stage of tuberculosis, and the anatomy of the ileocecal valve might well be reviewed here in order to understand this sign.

The end of the ileum telescopes or inserts itself through the colonic wall, carrying with it certain layers of that wall which project into the cecum in the form of two folds lying respectively above and below its

orifice and constricting the two segments of the valve. The outer covering or serosa and the outer half of the muscularis or longitudinal muscular fibers of the bowel, take no part in this infolding, but are stretched tightly across the cressae produced on the exterior by inversion and thus serve to preserve the fold and the formation of the valve (Figs. 12 and 13).

As seen from the interior, the valve is made up of two crescentic segments, the labium superius and the labium inferius, the lower being larger and placed in an oblique plane, sloping upwards and inwards (i.e., towards the cavity of the cecum). Between these two segments is situated the slit-shaped opening which runs in an almost anteroposterior direction with a rounded anterior and a pointed posterior extremity. The two segments meet at each end of the orifice and are then prolonged around the wall of the cecal cavity as two prominent folds, the frenulum valvulae coli. It is thought that when the cecum is distended and its circumference thereby increased, these frenula are put on the stretch and pulling on the two segments of the valve, they bring them into apposition and thus effect the closure of the valve. This might explain why the ileocecal valve often remains competent in atonic or normal colons, even under increased pressure of the barium column and why there is quick reflux into the terminal ileum as soon as the slightest contraction or spasm of the cecum takes place. Not only does the oblique manner in which the ileum enters

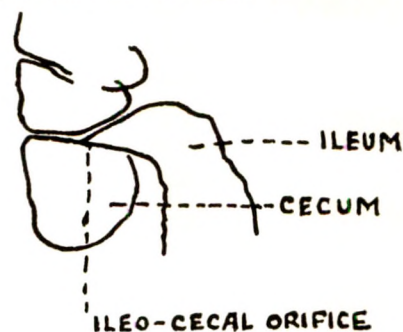


FIG. 13B. Diagrammatic drawing of Figure 13A.



or invaginates the colon (quite like the piercing of the bladder by the ureter) probably play a rôle in the matter of competency, but an additional factor is the

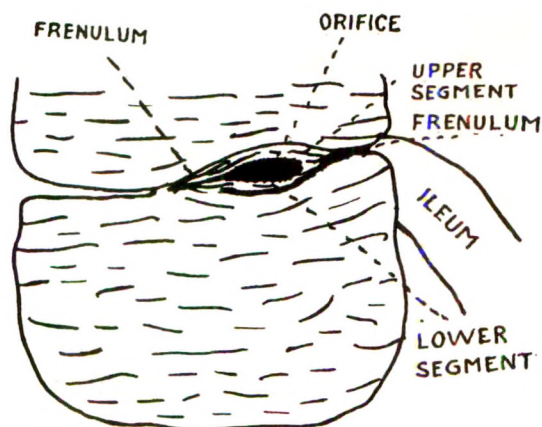


FIG. 14. Diagrammatic anatomical drawing of ileocecal valve as seen from inside of cecum.

usual position of the upper labium which usually projects further into the cecal cavity than the inferior lip, acting like a curtain and closing off the orifice. When

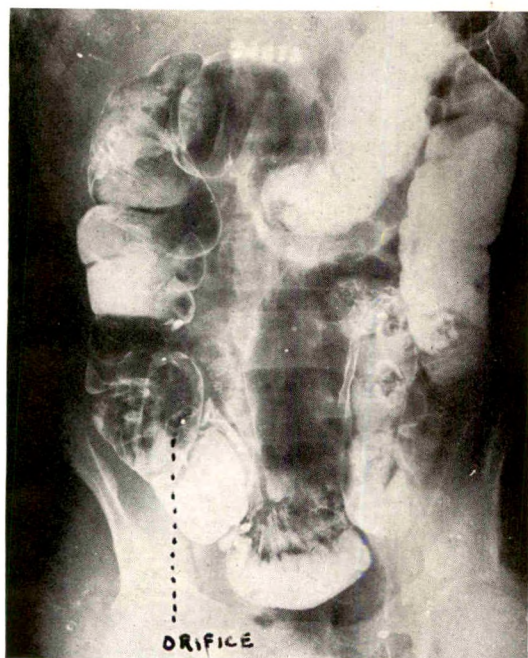


FIG. 15A. Orifice of ileocecal valve seen through air column in cecocolon.

the cecum contracts, this curtain is lifted by the rush of contents past it and with the orifice opened due to relaxation of the frenulum valvulae coli, the terminal ileum is filled. It is probably by this mechanism that we find almost without exception in every case of early ileocecal tuberculosis even where the orifice itself is not the seat of tuberculous ulceration, incompetency of the ileocecal valve. Although it is claimed by some investigators that the ileocecal valve is incompetent normally in as high as 80 per cent of all patients, in positive early cases we have practically always found it incompetent.

The roentgen appearance of the end of ileum in the sagittal plane is a cone or

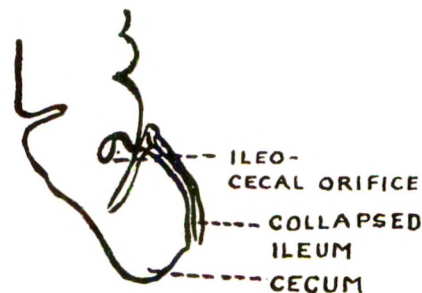
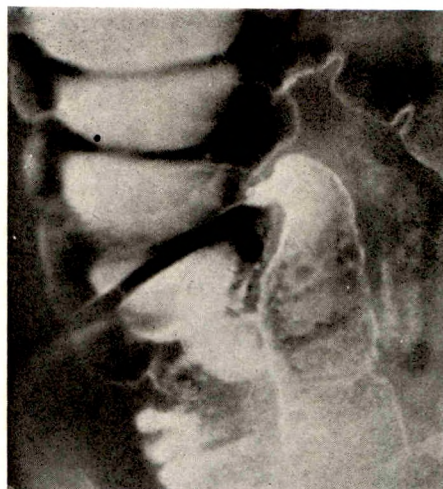


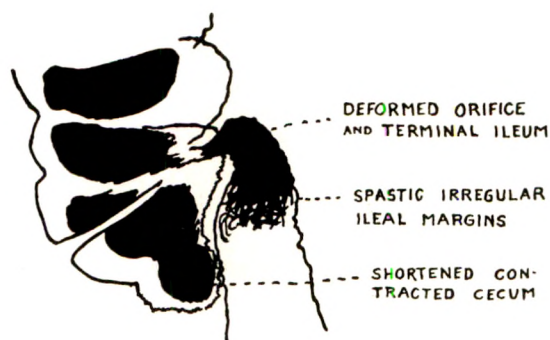
FIG. 15B. Same orifice as in Figure 15A, diagrammatically shown.

triangular-shaped segment with its apex invaginating the cecum (Figs. 14 and 15). In moderately advanced ileocecal tuberculosis with ulcerations on the frenula around the orifice and on the walls of the ileum just proximal to the orifice, it is natural that true irregularity in outline from the ulceration itself plus deformity of contour due to contraction of scar tissue produces changes in this normal appearance. Fleischner describes what he calls the inverted cone or triangle in which the pointed insertion of the terminal ileum is transposed (see Fig. 16) with divergence of the walls, like an inverted umbrella. But this is only one of the many deformities that are seen. Sometimes only the superior margin of the terminal ileum is irregular in outline, sometimes only the lower; oc-

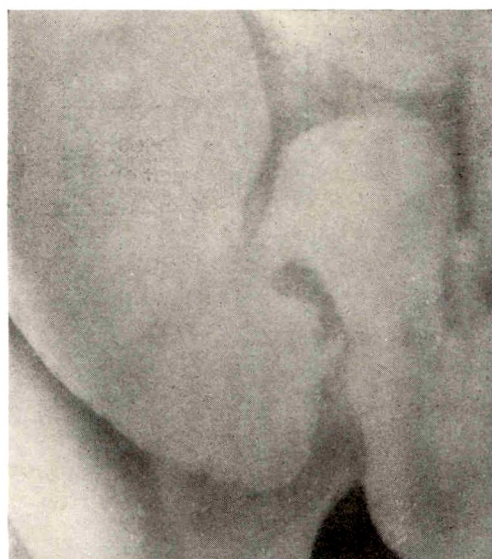




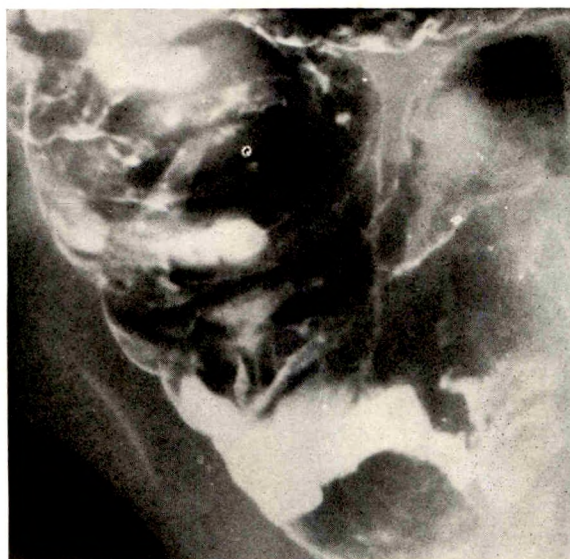
A



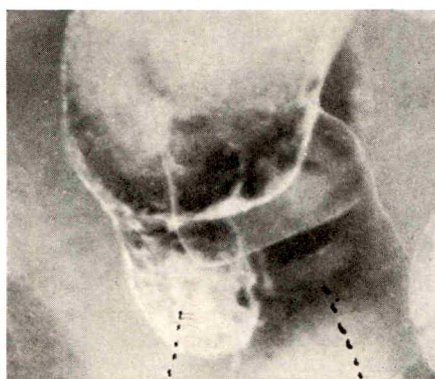
B



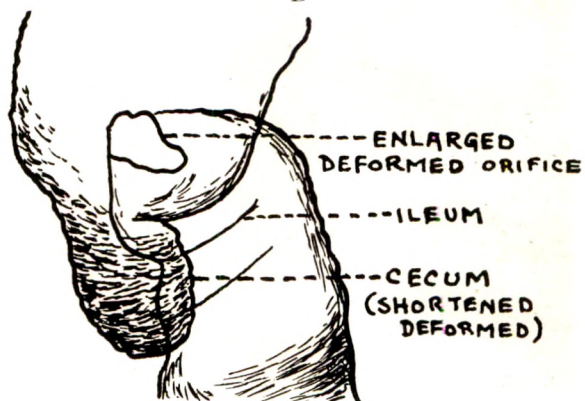
C



D



E



F

FIG. 16. Fleischner's signs. A. Double contrast film of ileocecal region. B. Diagrammatic drawing of A. C. Terminal ileum cylindrical instead of cone shape. D. Double contrast roentgenogram of C. E. Enlarged, ragged, deformed orifice seen through cecal air. F. Diagrammatic drawing of E.



casionally both walls are smooth and regular like an inflexible tube with no convergence of the ileal walls as it enters the cecum; in a number of cases we have seen the orifice of the valve end on through the air column in the cecum. In these cases, instead of an almond-shaped orifice, various distortions and irregularities of outlines are seen with usually an increase in the size of the orifice (Fig. 16).

### *Stage III. Advanced Stage*

In the third or advanced stage any or all of the findings seen in the first two stages may be evident, but the changes of the second stage have become marked. The cecum may thus be almost obliterated due to fibrous contraction, or the lumen may be obliterated by excessive hyperplastic tissue (Fig. 17).

The difference between the ulcerative, indurative and hyperplastic types becomes

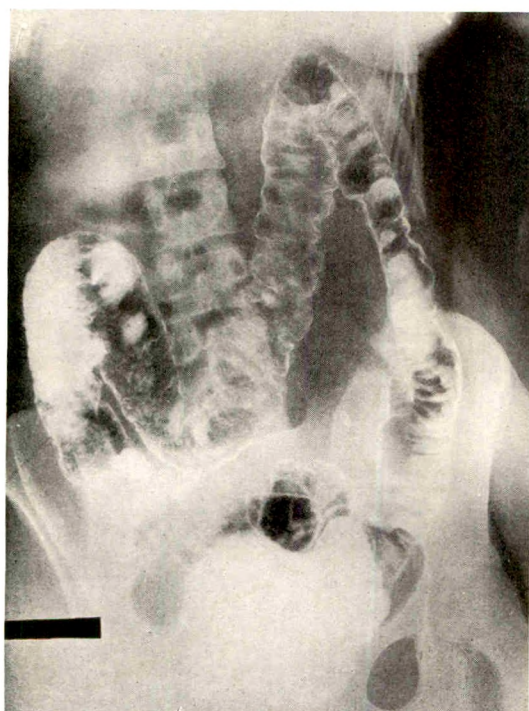


FIG. 17. Advanced hyperplastic tuberculosis of cecocolon, showing Fleischner's sign and irregular trabeculated appearance of mucosa as far as distal transverse colon.

more accentuated in this stage and not only do the enema studies reveal these differences better than the ingested meal studies, but the double contrast enema examination is best of all for the demonstration of these processes and their different variations. The hyperplasia about the ileocecal orifice may markedly distort and deform this region so that the true anatomicopathological deformities can no longer be visualized because the opaque injecta cannot get through. In these rarer instances, these deformities can be revealed only in the double contrast colographic examination. Air always enters the involved colon and carries with it enough of the barium suspension to reveal its deformed outline. One at first wonders why the barium injecta did not enter and reveal better than air, the sinuous irregularly contracted lumen instead of having been completely obstructed, coming to an abrupt end with a sharply limited margin (Fig. 18). Fischer explains this phenomenon as follows: The proximal normally distensible colonic walls fill up with the opaque mixture and distend proximally around the hyperplastic intraluminal tissue, causing complete compression occlusion of the lumen, thus making the barium column appear as if abruptly obstructed. When this happens, the double contrast method reveals the true process which otherwise would very closely simulate obstruction due to occluding malignancy. Without the double contrast method, it was formerly necessary in this event to fill the diseased segment by the ingested meal method and then carry out the enema study. The double contrast film in these cases obviates this extra preparation, revealing at once a very irregularly outlined narrow column of air with a stringy coating of barium. The slower the air is insufflated and the lower the air pressure, the more easily and thoroughly is the lumen of the affected segment outlined. In the moderate degrees of hyperplasia, the double contrast films often reveal flaky deposits of barium as if plaques of mucus



or necrotic tissue impregnated with barium were present. Barium deposits, due to irregular accumulations of barium in the unaffected recesses of colon, or in craters in or between the irregular elevations of hyperplastic tissue give a mosaic or marble-like graining to the appearance of the barium-coated colonic mucosa. This uneven distribution of residual barium coating stands out in marked contrast to the uniform coating in the left side of the colon.

In all the films, the lumen of the ascending colon is markedly narrow, greatest usually in the cecum and less in progressive degrees towards the hepatic flexure. The injected air and barium thus seem as if they were entering a long narrow funnel, the narrow outlet being in the cecum and the walls being grossly permanently defective. These changes are revealed best in the double contrast enema roentgenograms.

In the indurative and superficial ulcerative cases, the cecocolon may be narrower than that of the descending colon, but with relatively smooth, fixed, parallel walls. Rarely, the proximal transverse colon will also be involved. In this variety, the right colon simulates the appearance of the usual form of left-sided ulcerative colitis with the so-called "lead pipe" deformity of the walls. Hyperperistalsis is not frequently seen in this type during the roentgenoscopic examination, and even after evacuation a short column of barium residue may be seen in the right colon during the intermediary and double contrast examinations. Possibly the rigidity of the walls with inability to complete contraction, is the cause for this retention. Again, the double contrast films reveal greater detail of all the pathological processes, often even making possible visualization of the larger ulcers and the muco-caseous exudate on the mucosa.

In many of the late phases of this stage, marked left-sided muco-spastic or atonic colitis may also be present, but obviously offers practically no confusion in diagnosis.

The patient is usually in the terminal stages of pulmonary tuberculosis and the differential diagnosis is easy.

#### SUMMARY

1. Ileo-colography, using a double contrast air-barium enema is employed in the study of ileocecal tuberculosis, in conjunction with and after single contrast enema and an intermediary examination.

2. These examinations are more valuable than either the single contrast enema or the serial roentgenographic studies of Brown and Sampson alone because they not only furnish an equivalent of the spasms, hyperperistalsis and hypermobility, anastalsis, etc., with "filling defects," on which the diagnosis of early ileo-

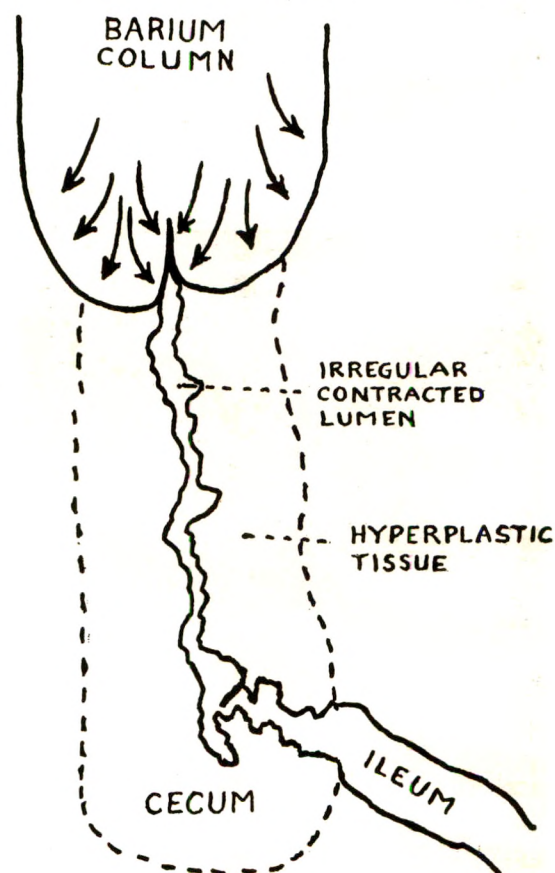


FIG. 18. Diagram showing advanced hyperplastic ceco-colonic tuberculosis causing complete obstruction to single contrast medium simulating malignant obstruction.



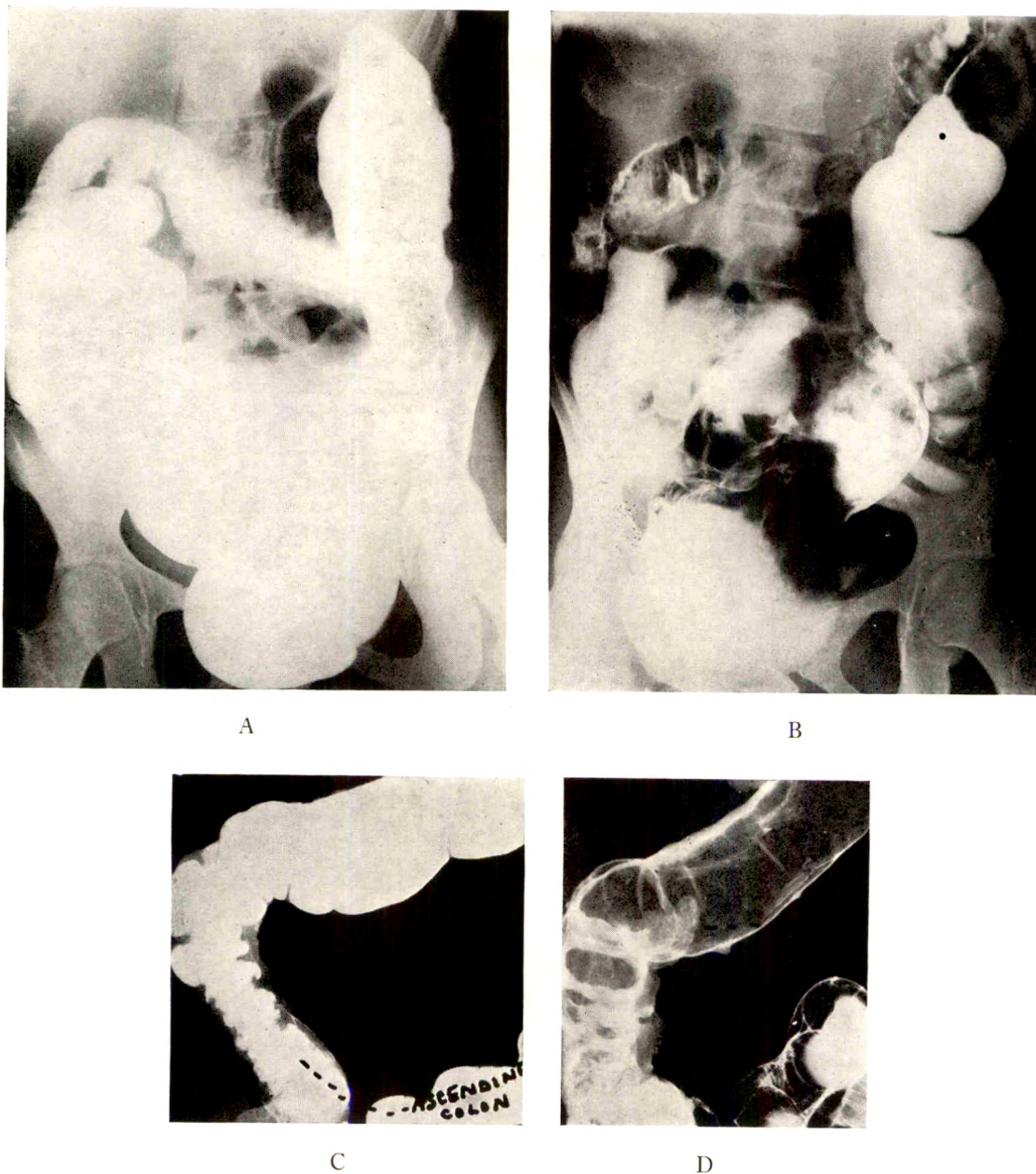


FIG. 19. Advanced hyperplastic ileocecal tuberculosis. A. Single contrast enema. B. Double contrast enema. C. Deformed ascending colon, single contrast enema. D. Deformed ascending colon showing irregularity of outline and hyperplastic tissue protruding into the lumen at hepatic flexure.

cecal tuberculosis is based in the serial examinations, but they manifest these equivalents earlier and more definitely. Many new phenomena are seen only in the double contrast roentgenograms, making possible a better concept of the tuberculous processes, their extent and intensity. .

3. The enema studies, as we have used them, are self-sufficient in making the diagnosis in all stages of ileocecal tuberculosis, allowing checks to be made on all the findings.

4. The double contrast roentgenograms reveal better than either the serial examina-

tions with the ingested meal or the single contrast enema roentgenograms, the anatomico-pathological changes of ileocecal tuberculosis, because both the intraluminal and parietal changes are more accurately and quickly rendered visible. This is especially true of the ileocecal valve, whose orifice can be seen in profile as well as end on through the air-filled cecum in the double contrast films.

5. The enema studies are made with

greater dispatch and less annoyance to the patient and require fewer exposures than the serial examinations.

These enema examinations have been made a routine measure of study in every case admitted to Eagleville Sanatorium. We have found them not only of inestimable diagnostic value, but also when repeated at regular intervals, of precise prognostic value, furnishing a nice index of therapeutic progress.

#### REFERENCES

1. ASKANAZY, MAX. Ueber des Verhalten der Darmganglien bei Peritonitis. *Verhandl. d. deutsch. path. Gesellsch.*, 1901, 3, 124-130.
2. BANDELIER, BRUNO, and ROEPKE, OTTO. A Clinical System of Tuberculosis. Second edition. Trans. by G. B. Hunt. Wm. Wood & Co., New York, 1923.
3. BÉCLÈRE and MÈRIEL. L'exploration radiologique dans les affections chirurgicales de l'estomac et de l'intestin. *Arch. d'électric. med.*, 1912, 21, 400; 417; 472.
4. BROWN, LAWRASON, and SAMPSON, HOMER L. Intestinal Tuberculosis. Lea and Febiger, Philadelphia, 1926.
5. CARMAN, R. D. Roentgenology of tuberculous enterocolitis. *J. Radiol.*, 1920, 1, 246-271; *J. Am. M. Ass.*, 1920, 74, 1371-1373. The Roentgen Diagnosis of Diseases of the Alimentary Canal. Second edition. Saunders, Philadelphia, 1930.
6. CARNETT, J. B. Intercostal neuralgia as a cause of abdominal pain and tenderness. *Surg., Gynec. & Obst.*, 1926, 42, 625-632.
7. CASE, J. T. Roentgen-ray studies of the ileocecal region and the appendix. *Am. Quart. Roentgenol.*, 1912, 4, 77-95. The roentgen-ray investigation of the colon. *Arch. Roentg. Ray*, 1915, 19, 375-387.
8. COLE, L. G., and EINHORN, M. Über Radiogramme des Verdauungstraktes nach Lufteinblasung. *Klin.-therap. Wchnschr.*, 1911, 18, 101-106.
9. FAULHABER, M. Die Röntgendiagnostik der Darmkrankheiten. *Samml. zwangl. Abhandl. a. d. Geb. d. Verdauungs- u. Stoffwechs.-Krankh.*, 1913, 5, Heft 1. Zur Diagnose der nicht strikturierenden, tuberkulösen karzinomatösen Infiltration des Coecum-ascendens. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1916-1917, 24, 303-308.
10. FISCHER, A. W. Ueber die Röntgenuntersuchung des Dickdarms mit Hilfe einer Kombination von Lufteinblasung und Kontrasteinlauf ("kombinierte Methode"). *Arch. f. klin. Chir.*, 1925, 134, 209-269.
11. FLEISCHNER, F. Ergebnisse der medizinische Strahlenforschung, 1928, 3, 359-423.
12. FLEMMING MØLLER, P. Roentgen examination of ileocecal tuberculosis with special reference to the so-called Stierlin-sign. *Acta radiol.*, 1921-1922, 1, 266-273.
13. FRANCOIS, J. Deux cas de tuberculose ileo-caecale avec symptome de Stierlin. *J. belge de radiol.*, 1922, 11, 334-345.
14. HURST, A. F. Constipation and Allied Intestinal Disorders. Second edition. Frowde, London, 1919.
15. KIENBÖCK, ROBERT. Zur Röntgendiagnose der Colitis ulcerosa. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1913, 20, 231-239.
16. PFAHLER, G. E. The roentgen rays in the diagnosis of gall-stones and cholecystitis, with improvement in technic. *J. Am. M. Ass.*, 1914, 62, 1304-1306.
17. PFAHLER, GEORGE E. Injection of air for roentgen diagnosis of tumors of bladder. *Am. J. ROENTGENOL.*, 1919, 6, 371.
18. PIRIE, A. H. See Archibald, E. The rôle of surgery in the treatment of intestinal tuberculosis. *Nat. Ass. Study & Prev. Tuberc. Tr.*, 1917, 13, 122; *Am. Rev. Tuberc.*, 1917, 1, 449-467.
19. RÉVÉSZ, VIDOR. Positives und negatives Stierlin-Symptom bei Ileocecal-Tuberkulose. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1918-1919, 26, 32-37.
20. RÖPKE. Der Wert der Röntgenaufnahmen des Lufteinblasung Magens für die Diagnose der pathol. Veränderungen desselben. *Festschr. d. 84. Versamml. deutsch. Naturf. u. Aerzte*, 1912.
21. SCHITTENHELM. Lehrbuch der Röntgendiagnostik. Springer, Berlin, 1924.

22. SCHLESINGER, E. Die Röntgendiagnostik der Magen- und Darmkrankheiten. Urban und Schwarzenberg, Berlin and Wien, 1917.
23. SIGMUND, A. Stierlin's phenomenon. *Casop. lék. česk.*, 1924, 63, 515. Abs. *J. Am. M. Ass.*, 1924, 82, 1576.
24. STIERLIN, E. Die Radiographie in der Diagnostik der Ileozökal tuberkulose und anderer Krankheiten des Dickdarms. *München. med. Wchnschr.*, 1911, 58, 1231-1235. Zur Röntgendiagnostik der colitis ulcerosa. *Ztschr. f. klin. Med.*, 1912, 75, 486-493.
25. WALSH, JOSEPH. Diagnosis of intestinal tuberculosis. *Nat. Ass. Study & Prev. Tuberc. Tr.*, 1909, 5, 217-222; also *N. York M. J.*, 1909, 90, 100-102.





## THE NORMAL POSITION OF THE PATELLA\*

By S. B. BOON-ITT, M.D.

BANGKOK, SIAM

IN ONE of the weekly Literature Seminars of the Department of Orthopedic Surgery of the State University of Iowa, an abstract of a paper by Murk Jansen on the "Genu Impressum and Patella Alta Vera in their Relations to the Occurrences of the Fat Pad Impingement and the Dislocation of the Patella" was presented. A question was raised as to what is the normal relation of the patella to the femur.

In reviewing the literature on this subject since 1916, nothing was found to answer the question. Shands has reported a study of 100 roentgenograms of patellae of children between the ages of two and a half and six years in regard to the ossification center. Moloney considered the mechanics of the patella and by means of computation showed that the patella actually increased the moment of rotatory force acting upon the tibia. Carey dealt in detail with the dynamics of histogenesis in regard to patella, knee joint, and the muscles of the thigh. But so far as the normal relation of the patella to the femur is concerned, nothing was found. Cunningham's "Text Book of Anatomy" gives the patella relation as, "In the position of extension, the patella is retained at such a proximal level in relation to trochlear surface of the femur, that the distal articular facets of the patella are in contact with the trochlea." Gray's "Anatomy" states that, "As the leg is carried from the flexed to the extended position, first the highest pair, then the middle pair, and lastly the lowest pair of the horizontal facets are successively brought into contact with the patellar surface of the femur." Piersol's "Human Anatomy" states, "The patella in the upright position, when the muscles are relaxed, has the lower part of the articular surface resting against the top of that

of the femur. When the muscle is contracted, the former is drawn entirely above the latter." Davis, in discussing the surface anatomy of the knee, says that, "About midway between patella and tubercle of the tibia on each side can be felt a groove which indicates the line of the joint and the location of the semilunar cartilages."

The study presented in this paper is based on lateral roentgenograms of 200 normal adult knees. These films were taken for clinical purposes relative to knee complaints, or in conjunction with the diseased knee for comparison. All films selected for this study were negative for any visible pathology of the joint. Generally, these roentgenograms were taken at a variable distance from the plates, ranging from 25 to 40 inches. This gave rise, therefore, to various sizes of knee shadows. Practically all lateral pictures of the knees were taken in the semiflexed position. It thus became necessary to resort to mathematical calculation to determine the position of the patella in full extension.

The method followed in this study is illustrated in Figures 1 and 2. The axes of both femur and tibia are first drawn through the centers of the shafts. These two axes  $AB$  and  $OC$  intersect and form an angle at  $O$ . The angle  $COB$  is measured and this gives the angle of extension of the knee. The line  $HI$  represents the plane of the articular surface of the patella. From the lower edge of the articular surface of the patella,  $G$ , line  $GM'$  is dropped perpendicular to the femoral axis  $AB$ . The length  $LM'$  will then be the distance of the lower edge of the articular surface of the patella from the lower edge of the external condyle of the femur,  $L$ , along

\* From the Department of Orthopedic Surgery, State University of Iowa.

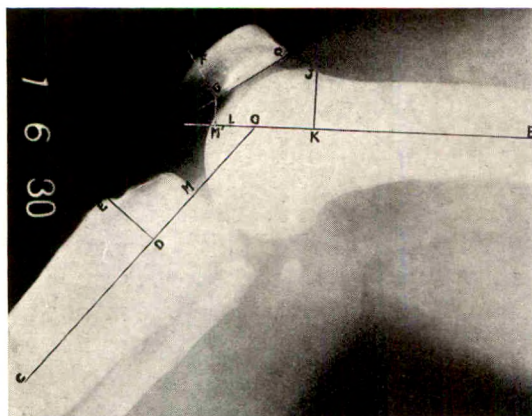


FIG. 1. Showing the method of approach and the measurements on a roentgenogram of a normal knee.

the axis of the femur. To get the thickness of the patella, line  $FG$  is drawn perpendicular to the line  $HI$ , and its length will represent the thickness. The line  $JK$  gives the distance of the patellar surface of the femur anterior to the axis  $AB$ . The distances of the anterior tubercle of the tibia from the tibial axis ( $DE$ ), as well as from the upper external border of the tibia ( $DM$ ), are measured. The line  $EF$  will correspond very closely to the ligamentum patellae, which is constant due to the inelastic nature of the ligament. Lastly, the joint spaces between femur and tibia, and between the femur and the patella are measured at the points where the two articular surfaces are more or less in contact. The width of the joint spaces will give the thickness of the articular cartilages and the interposed semilunar. All linear measurements are noted in millimeters and are estimated to 0.5 mm.

Figure 2 will illustrate the principle involved in the computation. The shaded tibia and patella show their theoretical positions in relation to the femur when the leg is fully extended. When the tibia is actively and fully extended as illustrated, the constructed irregular hexagon  $EDO-M'GF$  is transformed into a trapezoid  $E'D'K'F'$ . It is assumed in this computation that in full extension as such, the axis

of the femur will be in a straight line with the axis of the tibia in the sagittal plane. In actual normal condition it is recognized that the two axes do not subtend an arc of  $180^\circ$  but fall short of that value by a few degrees. It is further assumed that the articular surface of the patella is parallel to the axis of the femur: thus  $FG$ ,  $GJ$  and  $JK$  will all be perpendicular to the femoral axis if extended. The patella, it is found, does not lie exactly parallel to the femoral axis either, but forms a small angle with the latter. With these assumptions, the computation is worked. By cutting out the lower rectangle whose sides are  $E'L$  and  $D'K'$  (Fig. 3), the remaining section of the trapezoid will become a right triangle  $E'F'P$ . The hypotenuse  $E'F'$  is known, and the altitude  $F'P$  can be found by subtracting  $E'D'$  from  $F'K'$ , the latter being the sum of  $FG$ ,  $GJ$  and the articular cartilages of the patella and the femur, or  $G'J'$ . Knowing the two sides, the third unknown side can be computed by using the formula  $a^2 + b^2 = c^2$ . The base  $E'P$  of the triangle is equal to the line  $D'K'$ , and the latter is composed of three portions:  $DM$  or  $D'M'$ , articular cartilages with the

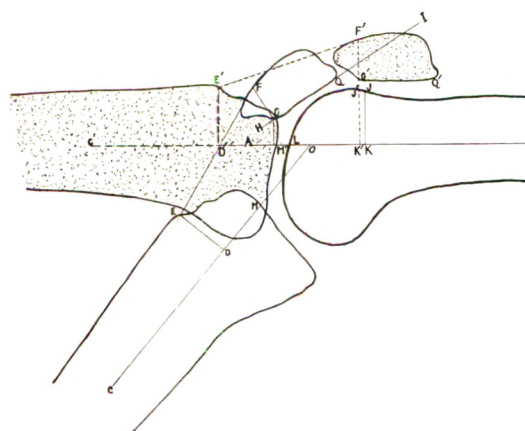


FIG. 2. Showing the principle involved in the computation of the index of patellar position. Index of patellar position in full extension =  $LK'/G'$ . Index of patellar position in semiflexion =  $LM'/G'$  or in general the index may be expressed thus  $\alpha/\beta$  where  $\alpha$  may be  $LK'$  or  $LM'$  and  $\beta$  may be  $G'$  or  $G'Q'$ .



semilunar ( $M'L$ ), both of which are known, and the third portion,  $LK'$ , the unknown. The computed value  $D'K'$  less  $D'M'$  and  $M'L$  will give the length of the lower edge of the articular surface of the patella above the lower edge of the external condyle of the femur along the femoral axis, or the maximum height to which the patella may theoretically ascend.

There are several objections to the above computation. It is acknowledged that this method of approach by computation is far from accurate. However, it appears that this closely approximates the existing conditions. In a few cases, the roentgenograms were taken both in semiflexed position and in fully extended attitude. It is found by comparison, that the computed values of the position of the patella correspond fairly closely to the actual conditions measured directly upon the roentgenogram of the fully extended knee (Fig. 4). The actual measurements upon the roentgenograms mean very little, as the same object taken at different distances will obviously give different sizes of shadows. It would have simplified the calculation a good deal if the tube to patient to plate distances could have been kept constant. Yet, had a constant distance been used in this study, it would have meant little, for in general practice such constant distance pictures cannot always be obtained. One

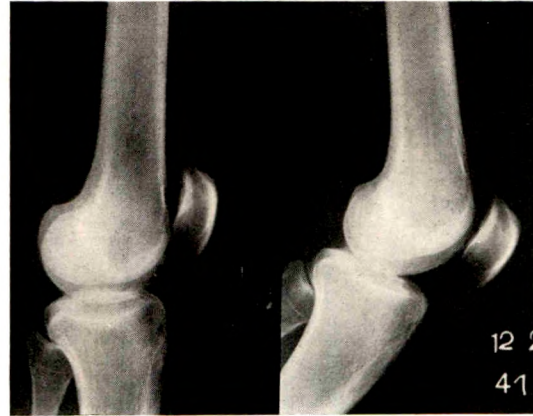


FIG. 4. Showing the same knee taken in semiflexed and in fully extended positions with the computation of the index.

$$\begin{aligned} M'L &= 11 \text{ mm.} & EF \text{ or } E'F' &= 53 \text{ mm.} \\ ED \text{ or } E'D' &= 24 \text{ mm.} & FG \text{ or } F'G' &= 21 \text{ mm.} \\ JK \text{ or } J'K' &= 22 \text{ mm.} & G'J' &= 4 \text{ mm.} \\ DM \text{ or } D'M' &= 12 \text{ mm.} & GQ \text{ or } G'Q' &= 36 \text{ mm.} \\ \text{thus } F'K' &= F'G' + G'J' + J'K' = (21 + 4 + 22) = 47 \text{ mm.} \end{aligned}$$

$$\begin{aligned} F'P &= F'K' - E'D' = (47 - 24) = 23 \text{ mm.} \\ a^2 + b^2 &= c^2 \text{ or } F'P^2 + E'P^2 = E'F'^2 \text{ or } (23^2 + x^2 = 53^2) \\ x &= 46.6 \text{ mm. or } E'P = 46.6 \text{ mm.} \\ E'P &= D'M' + M'L + LK' \text{ or } 46.6 = 12 + 11 + x, \\ \text{then } x \text{ or } LK' &= 23.6 \end{aligned}$$

$$\text{Index} = LK'/GQ = 23.6/36 = 0.66$$

While  $LK$  in fully extended position as measured directly from roentgenogram = 26 mm. Its index = 0.72.

may seek to eliminate this difficulty by using a unit of length obtained from the picture itself, for it is known that various parts in the same picture increase or decrease proportionately in the shadow picture. Thus the height to which the patella may ascend in full extension is expressed in terms of a unit obtainable from the patella itself. This unit is the length of the shadow of the articular surface of the patella. The term "index of the patellar position," or in brief, "the patellar index," is introduced to denote the ratio of the distance of the lower edge of the articular surface of the patella (projected upon the femoral axis) from the lower edge of the external condyle of the femur to the length of the articular surface of the patella. Expressed in formula:

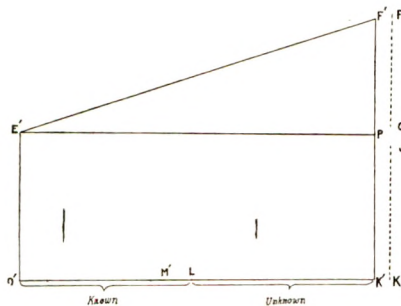


FIG. 3.

$$\begin{aligned} F'K' &= FG + GJ + JK; & F'P &= F'K' - E'D' \\ D'K' &= D'M' + M'L + LK' = E'P \\ (E'P)^2 + (F'P)^2 &= (E'F')^2 \\ LK' &= E'P - (D'M' + M'L) \end{aligned}$$

Index in fully extended position =  $\frac{LK'}{G'Q'}$  while

Index in semiflexed position =  $\frac{LM'}{GQ}$ .

Thus, in final readings of this study, the figures are given in terms of this index. The condition of the tone of the normal muscles of the thigh during the process of taking the roentgenogram may influence the height of the patellar shadow. But Gray's "Anatomy" states, "In the extended position, when the quadriceps femoris is relaxed, the patella lies loosely on the front of the lower end of the femur. During flexion the ligamentum patellae is put on a stretch." Practically all lateral views are taken in semiflexed position, and in such position the ligamentum patellae as well as the quadriceps muscle are put on a stretch, hence the contraction of the latter will move the leg rather than pull the patella up. It is only in full extension that the contraction or relaxation of the quadriceps plays an important part in the position of the patella, yet it can never pull the patella up higher than is permitted by the inelastic ligamentum patellae.

Following the above method, the index of the patellar position, both in the semiflexed and fully extended positions are computed. The computation for each case

is done separately, realizing that the unit used in one film differs in length from the unit of the next case. The results are then grouped together according to the angles of extension of the knees. The average lengths of the articular surface of the patellae, and the actual measured distances of the position of the patella projected upon the femoral axis are tabulated.

From Table I it will be noted that the mean index of the patellar position in semiflexed knees shows a gradual decrease as the degree of extension changes from 180-140, thus, between 180° and 170° the index is  $\frac{3}{4}$ , or 0.76, between 170° and 160° it is  $\frac{2}{5}$ , or 0.44, from 160° to 150° it is  $\frac{1}{5}$ , or 0.21, and from 150° to 140° it is  $\frac{1}{15}$ , or 0.08; however, from 130° down to 90°, the index becomes increasingly negative since the patella has passed below the lower edge of the femoral condyle. The mean index of the patellar position in full extension, however, averaged for each group, is more or less constant, varying from 0.71 to 0.79. The mean index in full extension for the entire 200 cases is found to be 0.753. The result obtained from this study agrees with the gross descriptions given in various textbooks of anatomy. It is found that the patellar surface of the femur extends upon the lower end of the

TABLE I  
SHOWING THE PATELLAR INDEX IN FLEXED POSITION

Angles	Number of Cases	Average Length of Patella	Average Height Ascent of Patella	Index in Flexion	Index Computed for Full Extension
Between					
180-170	6	36.0	26.0	0.76	0.77
170-160	8	31.2	13.7	0.445	0.78
160-150	15	32.5	5.4	0.21	0.76
150-140	38	32.9	2.5	0.085	0.71
140-130	55	34.1	-2.5	-0.065	0.75
130-120	47	32.4	-3.8	-0.11	0.79
120-110	21	33.4	-8.0	-0.23	0.74
110-90	10	33.7	-8.1	-0.27	0.75
Total cases	200				

Mean index in extended position for all cases, 0.753.



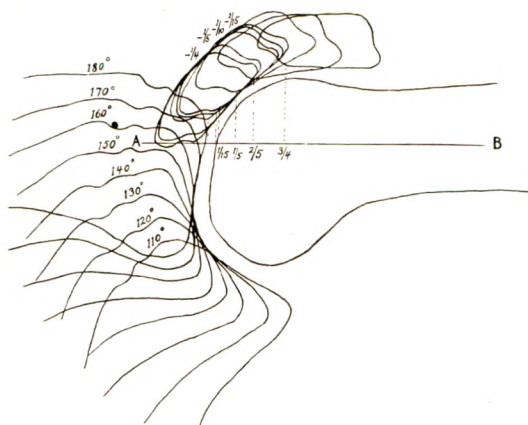


FIG. 5. Showing the relative positions of patella in various degrees of extension constructed from the findings in this study of roentgenograms of 200 knees.

femur about the length of the articular surface of the patella, measurement being taken along the femoral axis. Thus, an index of 0.75 means that the distal fourth of the patellar articular facet rests upon the proximal fourth of the trochlea of the femur. Figure 5, constructed from the results obtained in this study, shows the different positions of the patella in varied degrees of extension. These variations, plotted in graphic form, appear in Figure 6.

Jansen characterized patella alta vera as that condition in which the patella is too highly placed, with its lower pole being no longer at the level of the articulation. From this definition given by Jansen it follows that patella alta vera will have an index higher than one. In this study of 200 cases, it is found that 17, or 8.5 per cent, have an index of patellar position in fully extended attitude higher than one, 10 of which are but slightly above one (1.00-1.09), while the rest are between 1.10-1.36. The condition known as patella alta vera, or high patella, existed in a small percentage of these relatively normal knees.

#### CONCLUSIONS

1. The "index of patellar position" used in this paper refers to  $\alpha/\beta$ , where  $\alpha$  is

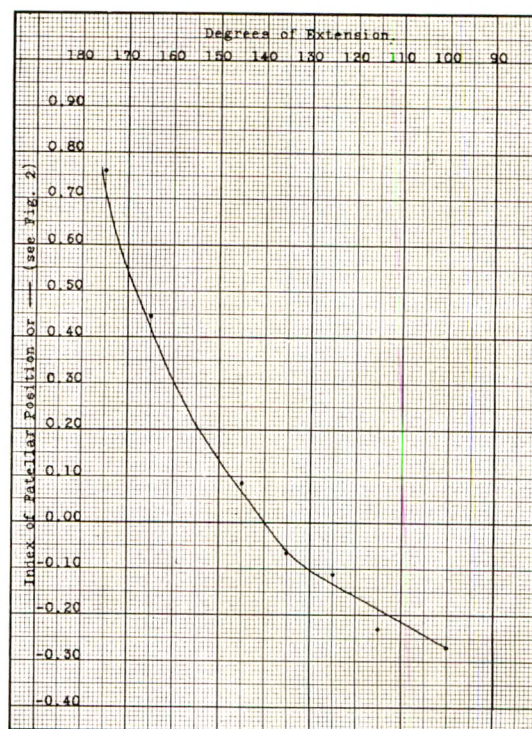


FIG. 6. Graphic representation of the relative position of the patella in various degrees of extension.

the difference in height between the lower edge of the articular surface of the patella and the articular surface of the femur, a quantity either positive or negative. This is measured by projecting this point of the patella upon the femoral axis or its prolongation, and measuring the distance along the axis from this point to the point where the articular surface of the femur intersects the femoral axis; and  $\beta$  is the length of the articular surface of the patella (see Fig. 2).

2. For determination as to whether the patellar shadow in a roentgenogram of the knee is too high or too low without complicated computation, a table was constructed to show the index of the patellar position in semiflexion as based upon the findings of the study of roentgenograms of 200 apparently normal knees. These indices were measured and computed for various degrees of extension:

Degree of Extension	Index
180-170	About 0.75 or $\frac{3}{4}$
170-160	About 0.40 or $\frac{2}{5}$
160-150	About 0.20 or $\frac{1}{5}$
150-140	About 0.06 or $\frac{1}{15}$
140-120	About -0.06 or $-\frac{1}{15}$
120-90	About -0.20 or $-\frac{1}{5}$

Thus, a patella may be said to be definitely high, if in a lateral view of a knee with about  $140^\circ$  of extension the lower edge of the articular surface of the patella is found to be about one-half of the patellar length above the lower edge of the articular surface of the femoral condyle, in other words, its patellar index in semiflexion is

$\frac{1}{2}$ , where normally as found in this study it ought to be about  $\frac{1}{15}$ .

3. The mean index of the patellar position computed in extended position for 200 knees was 0.753 or about  $\frac{3}{4}$ .

4. Of this series 8.5 per cent had a patellar index higher than one, 3.5 per cent of which showed a markedly high patellar index.

5. Following the definition of patella alta vera as given by Jansen, its patellar index would then be higher than one.\*

\* I wish to express my appreciation and thanks to Dr. Arthur Steindler, the Head of the Orthopedic Department of the State University of Iowa, for his very helpful suggestions and for the opportunity to utilize his material. Acknowledgment is also made to Dr. Joseph E. Milgram for his very kind assistance.

#### REFERENCES

- CAREY, E. J. Studies in dynamics of histogenesis; clinical application of dynamics of histogenesis, regarding origin, growth, and structural maintenance of patellar bone, knee joint, and related thigh muscles mobilization and traction trabeculae and pressure pillars of human patella. *Radiology*, 1928, 10, 234-251.
- CUNNINGHAM. Text Book of Anatomy. Fifth edition, p. 351.
- DAVIS. Applied Anatomy. Sixth edition, p. 541.
- GRAY. Anatomy of the Human Body. Twenty-first edition, p. 349.
- JANSEN, M. Genu impressum und Patella alta und ihr Verhalten zu bekannten Erscheinungen, wie Fetteinklemmungen, Knorpelschäden und Patellarluxation. *Ztschr. f. orthop. Chir.*, 1929, 52, 314-331.
- MOLONEY, J. C. The mechanics of the patella. *J. Bone & Joint Surg.*, 1927, 9, 476-481.
- PIERSOL. Human Anatomy. Eighth edition, p. 409.
- SHANDS, A. R. JR. An analysis of 100 x-rays of patellae in children between the ages of two and a half and six years with special reference to the center of ossification of patellae and a report of one case of delayed ossification of patella. *J. Bone & Joint Surg.*, 1926, 8, 824-831.



# RESULTS OF ROENTGEN THERAPY IN GOITER, BASED UPON OBSERVATIONS IN FOUR HUNDRED CASES\*

By GEORGE E. PFAHLER, M.D., and JACOB H. VASTINE, M.D.

PHILADELPHIA, PENNSYLVANIA

THE chronological development of the method of roentgen therapy in goiter has been ably reviewed by Holmes and Means, by one of us (G.E.P.), and by others. The etiology, symptomatology, and pathology have been discussed by such able authorities as Marine, Kimball, Else, Cole and Womack, Bircher, McCarrison, and others. For the sake of brevity these important phases of this subject have been omitted from this paper. It is sufficient to state that this method of treatment has been recommended by such able men as Borak, Curschmann, Møller, Schwarz, Rowe, Christie, Holzkecht, Saberton, Soiland, Grier, Stevens, Hayes, Simpson, Groover, as well as by other authors.

With regard to the pathology, Read, Graham, Black, Hertzler, Stahnke, Hunter, and others, find no characteristic anatomical or histological alteration in the thyroid that constantly corresponds to the clinical picture. Satisfactory clinical classifications have been made, especially by Else, and a modification of this classification has been used by us as follows (Table I):

TABLE I

OUR TREATED CASES HAVE BEEN GROUPED AS FOLLOWS

I Simple or Colloid.....	13
II Hyperplastic	
a. Non-toxic hyperplastic of adolescence.....	3
b. Toxic hyperplastic or exophthalmic.....	238
III Adenoma	
a. Non-toxic.....	26
b. Toxic.....	92
IV Thyroiditis	
a. Suppurative.....	0
b. Non-suppurative.....	2
V Malignancy	
a. Sarcoma.....	0
b. Carcinoma.....	26

Cases with hyperthyroidism treated with roentgen rays.....	327
Cases treated with radium.....	3
Non-toxic cases treated.....	44
Malignancies.....	26
Total cases treated.....	400
Total cases treated including malignancies.....	400
Simple or non-toxic goiters in which irradiation was not advised.....	132
Total.....	532

## RESULTS OF ROENTGEN TREATMENT

I. Simple, colloid, or non-toxic goiter cases are treated by us only when they have failed to yield to medical treatment or refuse operation. We have, therefore, treated only 13 out of 145 cases which were referred for treatment. Good results with disappearance of the goiter have been obtained in at least 10 of these 13 cases. The other 3 cannot be traced. The average time since treatment of these has been 8.7 years. During this time, there have been no unfavorable symptoms and no hypothyroidism. The results were obtained after from one to three series of treatments in 7 of the cases. In 3 cases there were five, six, and seven series. Four of these patients have gone through pregnancy, subsequently, without recurrence. These results correspond quite closely to those obtained by Grier, Meyer and others.

II. Hyperplastic Goiter (a. Non-Toxic of Adolescence). We have treated only 3 of these cases, but in all the enlargement of the gland disappeared. One of these patients passed through pregnancy later without a recurrence.

b. Toxic Hyperplastic, or Exophthalmic Goiter. This group is identified by the age incidence—young adult life usually, though exophthalmos occurred in our cases from three to fifty-nine years of age, the average

\* Read at the Thirtieth Annual Meeting, American Roentgen Ray Society, New York City, Sept 17-20, 1929.

age being thirty-four years; 84 per cent of our patients were females. The gland is usually smooth and firm, sharply defined and slightly or only moderately enlarged. The toxicity usually undergoes spontaneous remissions and exacerbations if uncontrolled. The onset is rapid. Metabolic rate is high in a well-established case. The patient appears nervous and has an anxious expression. Tachycardia and frequent myocardial degeneration are present. The blood pressure is usually normal or subnormal with a high pulse pressure. Fever is present in crisis. Tremor of the extended fingers is present. The skin is moist. There is occasional quadriceps weakness. There is exophthalmos in varying degrees with the associated eye signs. Alopecia is sometimes seen. The symptoms are palpitation, subjective nervousness, increased appetite, weakness, fatigue, and loss of weight.

We have classed with this group, cases presenting the other signs and symptoms, but lacking exophthalmos. We have also included in this group, cases in which there were definite toxic symptoms, but no palpable thyroid enlargement.

The methods of treatment available are medical, radiological or surgical. In our opinion a combination of the two former methods is the procedure to be adopted in most cases of this type.

We have treated 235 cases which clinically could be classed as exophthalmic goiter. These have been rather arbitrarily divided into three divisions as to degree of thyrotoxicosis. The results which we believe are directly attributable to irradiation are listed as cures, i.e., those cases in which the basal metabolism, taken routinely since 1921, is between plus 10 per cent and minus 10 per cent; the pulse has returned to normal; the weight has increased, approximately, to what it was before onset of toxic symptoms; nervous and other clinical manifestations have subsided, and in which the goiter has either completely disappeared or is so involuted as to be entirely unobjectionable from a cosmetic standpoint. We

have classed as improved those cases in which the basal metabolism is within normal limits or markedly decreased; in which all clinical signs of thyrotoxicosis have disappeared except a residual myocardial deficiency, which was present before institution of irradiation; or inoperable cases given radiation therapy to reduce the toxicity and prepare them for subsequent operative procedures. The response following irradiation is shown in Table II. Examination of this table shows 58.3 per cent of the cases definitely cured for an average of

TABLE II  
EXOPHTHALMIC GOITER—235 CASES

	Cured	Markedly Improved	Not Improved	Unknown
MILD				
No. of cases	17	9	7	10
Percentage	51.5	27.3	21.2	
Average No. of treatments	4.5	3.8	4.7	2
Average time observed	7.1 yrs.	1.1 yrs.		
MODERATE				
No. of cases	53	20	9	6
Percentage	64.5	24.4	11.1	
Average No. of treatments	6.6	4.8	3	1
Average time observed	6.0 yrs.	1.8 yrs.		
SEVERE				
No. of cases	56	32	13	3
Percentage	55.5	31.6	12.9	
Average No. of treatments	7	7.8	2	1
Average time observed	5.2 yrs.	3.4 yrs.		
TOTAL				
No. of cases	126	61	29	19
Percentage	58.3	28.3	12.9	
Average No. of treatments				1.5

Total Cured or Markedly Improved 86.6 per cent.



over six years. They were without evidence of toxic symptoms, visible thyroid enlargement, recognizable residual myocardial changes, and the exophthalmos was diminished. In addition 28.3 per cent were markedly improved. They were able to resume their occupation and their place in society, but their activities were restricted.

It can be seen by reference to Table III, that the percentage of cures is no greater in the mild than in the more severe cases.

TABLE III

EXOPHTHALMIC GOITER—DURATION OF SYMPTOMS BEFORE TREATMENT AND ITS RELATION TO THE RESULTS\*

	Cured	Markedly Improved	Not Improved	Unknown
LESS THAN 3 MONTHS—29 CASES				
No. of cases	19	5	1	4
Percentage	76	20	4	
Average No. of treatments	6	5	5	1
3 TO 6 MONTHS—33 CASES				
No. of cases	24	3	5	1
Percentage	75	9.5	15.5	
Average No. of treatments	7.5	3	3	2
6 TO 12 MONTHS—33 CASES				
No. of cases	22	6	4	1
Percentage	69	18.5	12.5	
Average No. of treatments	6.5	8	1.2	1
MORE THAN 1 YEAR—115 CASES				
No. of cases	59	31	15	10
Percentage	56	29.5	14.5	
Average No. of treatments	7	6.4	2.7	1.3

\* In 25 cases, the records did not include the duration of symptoms.

It may be concluded that the severity of the cases is no criterion by which the

response to irradiation may be predicted. The duration, however, of toxic symptoms prior to institution of irradiation is a very important factor. Reference to Table IV shows that 96 per cent of the cases treated

TABLE IV

EXOPHTHALMIC GOITER—PERMANENCY OF RESULTS IN CURED OR IMPROVED CASES

Time Since Treatment	Mild Cases	Moderate Cases	Severe Cases	Total
Less than 1 year	8	15	8	31
1-3 years	3	18	21	42
3-5 years	3	7	19	29
5-10 years	6	21	31	58
Over 10 years	6	13	8	27
Total	26	74	87	187

during the first three months of the disease were cured or markedly improved, and the average number of treatments necessary to effect a cure was less than in those of longer duration.

Of these 235 cases, 18, or 8.3 per cent, were subsequently operated upon. Of the 18 cases, 2, or 9 per cent, were post-irradiation recurrences, and of these 2, one recurred again after operation, but a second operation resulted in a cure. Both patients remained well. Ten of the 18 cases were unimproved after an average of four roentgen treatments, and we advised operation. With this combination, all have remained well. One patient had a rather stormy postoperative convalescence and was eventually relieved by medical measures. Four of the 18 cases were inoperable at the beginning, but were sufficiently improved by roentgen therapy and medical supervision to make operative procedures possible; one died as a result of operation; one developed postoperative tetany; the other 2 cases had an uneventful postoperative recovery. One of the 18 patients

had been relieved of the thyrotoxicosis by irradiation, but a large goiter was causing pressure symptoms and was removed surgically.

So far as we have been able to determine, 22 pregnancies in 17 patients were carried to a successful termination without recurrence of the previous goiter or toxic symptoms. The average time from the institution of roentgen therapy to delivery was three years and three months.

There were two *children*, both girls, treated in this series, one nine and the other three years of age. The former patient was given one series by another roentgenologist, three series of 50 per cent doses by us and then moved to a distant town. She was little improved and was operated upon six years after irradiation, with an ultimate uneventful recovery. The other child was first seen by us four years ago. She has received 16 treatments within two and a half years, of 50 to 60 per cent doses through a single portal. She has a slight remaining tachycardia and a marked exophthalmos. Visible or palpable evidence of the goiter has completely disappeared, her weight is about the average for her age and she is not nervous. She has been attending school and has been doing well. We regard her as markedly improved.

McGraw has published an excellent review of the literature upon exophthalmic goiter in children. He cautions against too radical surgical measures in these cases due to the likelihood of myxedema. Dinsmore has reported a series of 48 cases of exophthalmic goiter in children and states that they are extremely susceptible to all kinds of operative procedures and must be handled with extreme care. The surgical mortality is high in children and for this reason we believe that radiation therapy should be first employed and by this procedure relief of the thyrotoxicosis will usually be obtained and surgical measures with the attendant risk avoided.

Of the 235 cases of exophthalmic

goiter, 19, or 8 per cent, were *postoperative recurrences*. The average number of treatments given was a little over five. Of the 19 cases, 7, or 37 per cent, were cured; 8, or 42 per cent, were markedly improved; 4, or 21 per cent, were not improved. These last 4 cases received only one treatment each. Three of these postoperative cases died—2 as a result of goiter, one from influenza. The results from roentgen therapy in the recurrent postoperative cases we feel are quite encouraging, but they are not so good as in the cases not previously operated upon.

*Sequelae.* Of the occasional unfortunate sequelae, 10 patients, or 4.3 per cent, developed telangiectases in varying degrees. These patients were among the early cases and had an average of ten series of treatments, through four portals each, varying from 40 to 75 per cent skin erythema dose. This greatly exceeds the amount of radiation which we have recommended during recent years. Patients in whom there is an angioneurotic tendency are sometimes seen to develop an erythema directly after treatment. This is not a true radiodermatitis and does not lead to telangiectasis, but such patients should be given lower doses than the average individual.

*Hypothyroidism.* Four of these patients, or 1.7 per cent, subsequently had a metabolic rate which was less than normal. These patients received an average of eleven series each—more than we prefer to give at the present time. Of these, only 2 had clinical symptoms of hypothyroidism which necessitated administration of desiccated thyroid. One of these 2 has recovered, and the other is improving.

Hoarseness was not present in any patient in whom it was not present previous to irradiation. Tetany did not occur as a post-irradiation complication.

Of the 235 cases of exophthalmic goiter, 19 have died from various causes (Table v). Eight patients died of com-

TABLE V

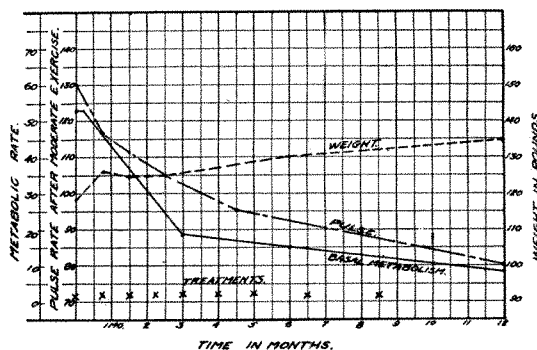
OF THE 235 CASES OF EXOPHTHALMIC GOITER, 19 HAVE DIED FROM CAUSES SHOWN BELOW

Severity	No. of Treatments	Time after Last Treatment	Improvement from Irradiation	Cause of Death
Severe	13	4 years	Cured	Pneumonia
Moderately severe	13	10 years	Cured	Pneumonia
Postoperative recurrence	1	1 year	Improved	Influenza
Moderately severe	14	8 years	Improved	Carcinoma of throat
Moderate	1	2 months	Improved	Gangrene of leg
Severe	6	5 years	Improved	Gangrenous laryngitis
Moderate	7	5 years	Cured	Unknown, not hyperthyroidism
Moderate	3	1 year	Improved	Hypertension present many years
Severe	7	2 years	Improved	Myocarditis
Moderate	7	5 years	Cured	Tuberculous meningitis
Severe	6	3 years	Improved	Nephritis—present before irradiation
Severe	2	2 years	Improved	Nephritis
Severe	3	1 year	Improved	Thyroidectomy
Severe	3	2 months	Unimproved	Hyperthyroidism
Severe	2	2 months	Unimproved	Hyperthyroidism
Severe	1	2 years	Unimproved	Hyperthyroidism
Critical	1	5 days	Unimproved	Hyperthyroidism
Critical	1	8 days	Unimproved	Hyperthyroidism
Moderately severe	1	1 month	Unimproved	Hyperthyroidism

ditions entirely unrelated to the thyroid. One died of hypertension present many years—antedating the goiter. Two died of nephritis and one of myocarditis. These may have resulted from the thyrotoxicosis. When treated they were very severe, probably inoperable, cases. One patient received three treatments with improvement. A thyroidectomy was performed a year later which resulted fatally. This patient was sufficiently improved by roentgen therapy for the surgeon to regard her as an operable case. Six of these 19 were very advanced cases, in a critical state of toxicosis, failed to respond to irradiation and died before we could give more than one series of from one to three treatments. In 2 of these cases it was necessary to employ radium in the home. It is interesting to note that 2 of these last 6 cases were postoperative recurrences and degenerative changes were advanced due to prolonged toxicosis.

The composite Chart 1 shows the response to irradiation and especially the

CHART NO. 1.  
COMPOSITE CHART—EXOPHTHALMIC GOITER.



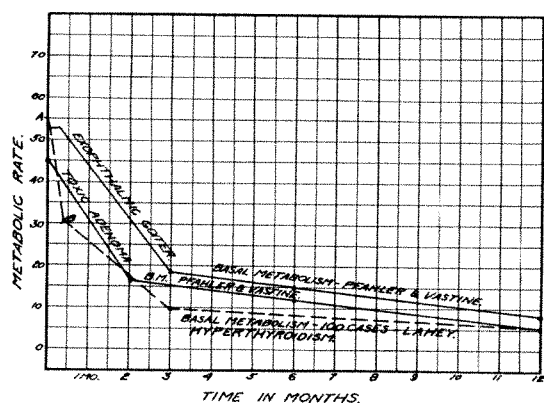
relations of the gain in weight to the decrease in pulse rate, and the decrease in the metabolic rate.

The composite Chart 2 gives a comparison of the drop in the basal metabolic rate during roentgen therapy, as shown by our records, compared with the record

of 100 cases treated surgically by Lahey. The metabolic rate decreases more slowly following roentgen therapy, but it must be borne in mind that the marked drop between A and B in the curve of surgical

CHART NO. 2.

COMPARISON - SURGICAL &amp; RADIOLOGICAL RESPONSE.



cases is effected by rest in bed with medical supervision before any surgical measures have been employed. The patients treated roentgenologically are ambulatory and often pursuing their usual activities.

III. *Adenoma.* a. *Non-toxic.* This is characterized by a rather large, firm, nodular, usually circumscribed thyroid enlargement, bosselated to palpation. These occur in the later decades of life, the average age of the 26 cases treated by us being 44 years. These adenomas usually become progressively larger over a period of years, the average duration in this small series of cases being 6.6 years from time of first noticing the goiter until coming under our care. Medical treatment is ineffectual in relieving this condition, or retarding its progress. Iodine is definitely contraindicated because it not infrequently converts an innocuous adenoma into a severe toxic case. Rather small localized adenomata, in which localized doses of roentgen rays may be employed, are those in which irradiation offers the most hope of improvement. The duration of the goiter from a statistical analysis of our cases is unrelated to the

response which may be expected from irradiation. In spite of this, we treat the adenomas of shorter duration more optimistically than those of longer duration. Large adenomas are better treated surgically than radiologically. Numerous cases were seen by us and not treated.

There were 26 patients with small non-toxic adenomas referred to us. These were practically all given localized doses to the adenoma through single portals. In over 56 per cent of these, there was a complete disappearance of the adenoma to palpation for an average of seven years without recurrence. In 26 per cent of these 26 patients, there was a marked decrease in size so that the goiter was scarcely visible. The average duration of these cases is also seven years without recurrence. A disappearance of the goiter was effected with an average of four localized doses of 50 to 75 per cent. Four cases after an average of 3.2 treatments showed no improvement and were subsequently operated upon. One patient died from pulmonary tuberculosis two years after treatment for goiter. There were no post-irradiation skin changes observed. None of the patients have shown any evidence of hypothyroidism.

b. *Toxic Adenoma.* These present the same characteristics upon physical examination as the adenomata in which symptoms of a thyrotoxicosis have developed. These are usually seen in the later decades of life, the average age in our series being 46.7 years. They are usually of long duration, the average being 9.3 years. It is generally thought that all adenomas, eventually, unless arrested in their progress by surgical or radiological measures, manifest evidence of hypersecretion. Unlike the exophthalmic goiters, however, these symptoms usually develop insidiously and the duration of toxicity is often rather vague. This occurred more frequently in females, 82.5 per cent of our series. The cardiac changes are often more pronounced in a well-established



lished case than in exophthalmic goiter, due to the longer duration of toxicosis and the more advanced age of the patient. There is less loss of weight and the nervous symptoms are less pronounced than in exophthalmic goiter. Exhaustion is usually greater. The metabolic rate is usually lower than in exophthalmic goiter.

In our series of 92 cases of toxic adenoma, the response to irradiation with special

TABLE VI  
RESULTS OF ROENTGEN THERAPY IN 92 CASES OF  
TOXIC ADENOMA

	Cured	Markedly Improved	Not Improved	Unknown
MILD				
No. of cases	15	11	4	4
Percentage	50	36.7	13.2	
Average No. of treatments	3	4.5	4.7	1.5
Average time observed	3.8 yrs.	1.4 yrs.		
MODERATE				
No. of cases	25	11	3	2
Percentage	64.0	28.2	7.8	
Average No. of treatments	7	5.2	4.8	
Average time observed	6.0 yrs.	1.1 yrs.		
SEVERE				
No. of cases	7	9	0	1
Percentage	43.8	56.2	0	
Average No. of treatments	7.2	6.3	0	1
Average time observed	6.7 yrs.	2.1 yrs.		
TOTAL				
No. of cases	47	31	7	7
Percentage	55.3	36.5	8.2	
Average No. of treatments				
Average time observed				

• Total Cured or Markedly Improved 91.8 per cent

relation to the duration of the toxic symptoms could not be definitely determined due to the insidious development of the toxic symptoms and inability to definitely know the duration.

The response to roentgen therapy with relation to the severity of the toxic symptoms is shown in Table VI. It can be seen that the percentage of definite cures is slightly less than in exophthalmic goiter, but the percentage of cases markedly improved is definitely greater. In our series of 92 toxic adenomata, *91.8 per cent were either cured or markedly improved.* This compares very favorably with the other methods of treatment, particularly when it is noted that the cases have averaged approximately six years under observation since roentgen treatment. Only one case has shown a subsequent adenoma. This developed on the opposite side to that treated and was first seen

TABLE VII  
TOXIC ADENOMA—PERMANENCY OF RESULTS

	Mild	Moderate	Severe	Total
Less than 1 year	7	5	4	16
1-3 years	8	10	1	19
3-5 years	2	3	7	12
5-10 years	4	10	3	17
Over 10 years	5	7	2	14
Total	26	35	17	78

six years after disappearance of the previous adenoma. It was not a recurrence but a new growth. The severity of the cases did not appreciably affect the response to irradiation, the severe cases responding as well or better than the milder cases. Duration of the goiter played no rôle. Duration of toxic symptoms apparently had little effect upon response, though this is usually rather indefinite.

The enlargement in exophthalmic goiter usually disappears completely following irradiation, but next to the exophthalmos is the last symptom to disappear. There is usually a marked decrease in size of the adenomatous type of goiter, but frequently not a complete disappearance. Frequently a small palpable nodule remains which is of no significance unless causing pressure symptoms and then it can easily be removed surgically with little inconvenience to the patient.

In 7 cases, or 8.2 per cent, of this series, there were subsequent operations for goiter. The average number of treatments given previous to operation was 6.7. Two cases failed to show a response to roentgen therapy. In 5 cases there was a marked relief of toxic symptoms, but operation was performed for persistent thyroid hypertrophy which was causing pressure symptoms. Of the 7 patients operated upon, 6 are now well or markedly improved. One patient was improved by radiotherapy, but died during a thyroidectomy a year later.

Three cases, or 3.3 per cent, of this series were postoperative recurrences. Of these, one was definitely cured; one markedly

improved, and one failed to respond to irradiation.

Twelve of this group of cases of toxic adenoma have died, which is not surprising when the advanced age of some is considered as shown in Table VIII.

There are only 3 of the 12 deaths in the 92 cases of toxic adenoma in which the fatal termination could be attributed to the goiter. One patient was improved by roentgen therapy but died during a thyroidectomy, a year later. One patient received 2 roentgen treatments without improvement and died six months later as a result of the thyrotoxicosis. One patient was markedly improved following four roentgen treatments, but following administration of iodine became rapidly worse and died. At this time we would again like to caution against the administration of iodine to patients with adenomata.

*Sequelae in Toxic Adenoma.* In 4 of the 92 cases of toxic adenoma, there were skin changes with telangiectasis, after seven, eleven, thirteen, and twenty-three series of treatments, the latter twenty-three treatments being single portals over the adenoma. This is greater dosage and

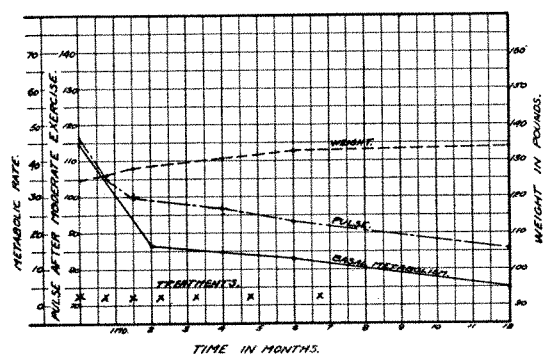
TABLE VIII  
CAUSES OF THE 12 DEATHS IN THE CASES OF TOXIC ADENOMA

Severity	No. of Treatments	Time after Last Treatment	Improvement from Irradiation	Age at Death	Cause of Death
Mild	3	11 years	Cured	58	Carcinoma of uterus
Mild	6	8 years	Cured	47	Tuberculous pyelitis
Mild	2	2 months	Improved	48	Lung abscess following extraction of tooth
Severe	9	4 years	Improved	47	Cause not known
Severe	7	4 years	Cured	64	Cause not known; not goiter
Moderate	8	10 years	Cured	75	Cause not known; not goiter
Moderate	4	2 years	Improved	55	Hysterectomy
Moderate	6	20 years	Cured	75	Heart disease
Severe	9	6 years	Improved	68	Nephritis
Moderate	8	1 year	Improved	45	Thyroidectomy
Moderate	2	6 months	Not improved	65	Toxic goiter
Severe	4	4 months	Improved	60	Toxic goiter—following iodine administration

more prolonged irradiation than employed at the present time. One of these patients was later operated upon.

None of the cases developed symptoms of hypothyroidism following irradiation, and in none was there manifested any evidence of other unpleasant sequelae except those already cited.

CHART NO. 3.  
COMPOSITE CHART - TOXIC ADENOMA.



Composite Chart 3 shows the representation of the weight, pulse, and metabolic rate for cases of toxic adenoma and their response to irradiation.

iv. *Thyroiditis. a. Suppurative.* Roentgen therapy plays a small rôle in the treatment of this rather rare condition. It is conceivable that a single mild dose might be efficacious in the relief of pain as in some other infections, but we have had no experience in treating suppurative thyroiditis.

b. *Non-suppurative Thyroiditis.* This condition is less rare. Pemberton, in a series of 500 cases of exophthalmic goiter has reported 54, or 11 per cent, presenting varying degrees of thyroiditis at the time of operation. He states that it is patients of this type who later report with myxedema.

In our series of cases there were probably many with thyroiditis which could not be recognized clinically. There were 2 in whom the clinical evidence strongly favored thyroiditis, i.e., rapid enlargement of the thyroid, with marked tenderness of the gland, associated fever and

tachycardia. Nervous symptoms were not pronounced. One patient was apparently completely relieved of all thyroid enlargement and the associated symptoms, two weeks after a single dose of roentgen rays over the thyroid. In the other patient, relief was obtained more slowly, five series of treatments through two portals each, over a period of five months being necessary to obtain a complete relief from symptoms and a disappearance of the thyroid enlargement. No evidence of hypothyroidism developed in either of these cases, though two years has elapsed since the treatment of the former patient and nine years since the treatment of the latter.

Christie has reported a very satisfactory result from roentgen therapy in a case of thyroiditis. Groover has also reported on this condition.

v. *Malignancies of the Thyroid.* We have treated 26 malignancies of the thyroid gland. One of us (G.E.P.) reported upon 10 of these in 1922. Time does not permit a discussion of these at the present time.

*Substernal Goiter.* This condition presents a rather difficult problem to the medical profession. Surgical removal is difficult and attended by a rather high mortality. The possibility of mediastinitis is always great following surgical interference and not infrequently hematomas develop which sometimes cause a fatal embarrassment of the respiration. Shock is always great in these cases and this is particularly distressing in toxic cases. The most annoying symptoms usually resulting from substernal goiters are those due to pressure. Grier has analyzed 26 cases which he had irradiated, and concludes that irradiation is of value in treating exophthalmic goiter and adenoma, but is of little value in the colloid types of goiter. He prefers high voltage roentgen therapy in 80 per cent skin erythema doses through anterior and posterior portals.

We have treated 12 cases of substernal goiters, 6 of which had exophthalmos and could be regarded as that type of goiter.

A disappearance of the goiter was effected in 5 of these cases. One patient received only one treatment and was unimproved. Three of these 12 substernal goiters occurred in older individuals without exophthalmos and were probably adenomata. Two of the 3 were unimproved by low voltage roentgen therapy over the anterior mediastinum. One was improved by a total of 200 per cent of an erythema dose of roentgen rays generated by a high voltage machine, given in fractional doses over a period of two months. Two cases with non-toxic substernal goiter were not improved by low voltage irradiation, one having received two treatments and the other only one. The results in one case after a single treatment is unknown.

*Thymic Enlargement in Goiter.* There were 23 cases in which thymic enlargement could be definitely recognized roentgenographically. Twenty-one of these were cured and 2 greatly improved by irradiation of the anterior mediastinum and thyroid region. Thymic enlargement was probably present in a far greater number of cases in which it could not be demonstrated. Hunter states that the thymus is frequently found to be present and hypertrophied in autopsies on cases dead of hyperthyroidism.

The simultaneous presence of *uterine fibroid and goiter* has already been reported and cases have been cited by Brown in 1924, Khoór in 1926, and Lindenberg in 1928. In our cases there were 8 in which the presence of uterine fibroid was recognized. Routine pelvic examinations have not been made in cases of goiter and the patients have not been minutely questioned concerning genitourinary symptoms, and thus many small, silent fibroids have probably been overlooked. In the 8 patients, fibroids occurred in 3 with exophthalmic goiter, 4 with toxic adenoma and one with non-toxic adenoma. In 2 of the 8 patients, myomectomy was performed. In the rest the fibroids were treated by irradiation, with a disappearance of the fibroid or marked decrease in size in all of them.

There was a disappearance of the goiter or marked diminution in size in 7 of these 8 cases following irradiation of the goiter. One patient was unimproved after 2 treatments.

#### TECHNIQUE

The technique employed in the treatment of goiter has been fragmentarily discussed in connection with the treatment of different types of goiter. We will briefly review this. The anterior cervical region is divided into four areas—two anterior and two lateral—each approximately 5×15 cm. in size, with the anterior areas extending well down over the upper mediastinum. The upper limit is taken well below the cricoid cartilage, 2–3 cm., and the larynx protected with lead. The rays are directed medially and downward so that a cross-firing effect is produced.

The factors employed by most roentgenologists in the usual treatment of goiter are quite similar and the technique has become fairly well standardized. We employ a 9 inch spark gap, 5 ma., at a skin target distance of 10 inches, with 6 mm. Al filtration. In simple or colloid goiter we give one or two series of 30 to 40 per cent skin erythema dose over two to four areas. This is attended by practically no danger of hypothyroidism. In adenoma, localized doses are usually employed, sometimes cross-firing the adenoma through two portals. In the milder toxic cases we give an initial 50 per cent skin erythema dose through each of the four portals; this is repeated in three weeks with less radiation, 40 to 50 per cent usually being employed. The interval may be prolonged to from four to eight weeks and the amount of irradiation gradually reduced. Later factors are largely determined by the response to irradiation. It is probably wiser to give 30 to 40 per cent initial skin erythema doses in the severer cases, gradually increasing to 50 per cent S.E.D.

The number of such series must be determined by the individual response of



each patient. We are usually rather loath to give more than eight or ten series, and expect almost complete relief after six series. Many patients have been seen in which scarcely any benefit could be noted until after six or eight series, and then the response has been very rapid. We believe, however, if a patient is not definitely improved after three or four series and a lapse of two to three months after instituting radiation therapy that other measures should be employed. The patient's weight, pulse after rest and mild exercise, the general condition and the condition of the skin are recorded at each visit. Frequent metabolic determinations are advisable, particularly in patients in whom there was a very great elevation previous to beginning treatment. In these cases when the metabolic rate has reached plus 20 per cent, we usually prefer postponing treatment, and not infrequently in one or two months it has reached a normal level as a result of the previous treatments.

Routine dental examinations are made to determine the presence of focal infection. It is not an uncommon experience to note a marked improvement following the removal of foci of infection. The tonsils are examined and removal advised if they are at all questionable. The sinuses are examined if there are any suggestive symptoms referable to them. This examination, however, is not made routinely. A routine chest examination is made to record the size of the heart, determine the presence of thymic enlargement or substernal goiter. Pulmonary tuberculosis presents many symptoms simulating hyperthyroidism and it is well to exclude this condition by the chest examination. Oblique films of the upper mediastinum as described by one of us (G.E.P.) in 1921 are valuable in outlining the lower limits of the thyroid enlargement.

#### ASSOCIATED MEDICAL TREATMENT

This, we believe, is a very important consideration in the management of cases

of goiter. Reference to Chart 2 shows the marked relief obtained in Lahey's cases in ten days of hospitalization under medical care prior to operative measures. The decrease in the metabolic rate in this time is from 56 to 31 per cent, or an average drop of 25 per cent. This is usually obtained by the administration of iodine, sedatives and rest. It is our opinion that iodine in conjunction with roentgen therapy is not generally wise. Several patients with exophthalmic goiter have been observed whose improvement was definitely accelerated by administration of iodine, but several were apparently made worse by this drug, and upon discontinuing it improvement went on uninterruptedly. In very severe cases under hospital regime, Lugol's solution for several weeks is often efficacious when combined with roentgen therapy but we do not feel that it should be employed routinely. We have observed patients with toxic adenoma become worse after administration of iodine. One patient who was improving under roentgen therapy was given iodine, with marked increase in toxicity and a rapidly fatal termination. Iodine should, in our opinion, not be given to patients with toxic adenoma and only in selected cases of exophthalmic goiter.

The general medical care of the patients is usually left to the discretion of the family physician. We sometimes recommend the use of quinine hydrobromide in 5 gr. doses t.i.d. until ringing in the ears occurs. Digitalis is sometimes suggested, though this drug is less effective in the tachycardia and decompensations of hyperthyroid origin than in other cases. A list of general instructions is given to the patient recommending rest, a high caloric diet of easily digested foods, and avoidance of stimulants.

A prescription for Dodd's lotion (pulv. zinc oxide dr. 4, glycerine fldr. 1, phenolis min. 30, aq. calcis [fresh] fl. oz. 8, Sig: Apply locally with a cotton sponge) is empirically given to be applied to the neck

TABLE IX  
RESULTS OF ROENTGEN THERAPY IN HYPERTHYROIDISM  
(From the Literature)

Author	Year	No. of Cases	Im- proved	Cured	Total Cured or Markedly Improved	Remarks
Pfahler	1908	51	per cent	per cent	per cent	
Fischer	1921	490			82	
Holmes and Means		44	60	37	97	
Sielmann	1923	328	44.5	50.5	95	12 per cent postoperative re- currences
Simpson	1924	200			70	
Saberton	1924	not given		75		
Read	1924	50	24	50	74	8 cases still under treatment 3 cases not traced
Jenkinson	1925	400			80	o-Myxedema o-Parathyroid injury o-X-ray burns
Allison	1925	175				
27 consecutive			11	78	89	
Hardman	1926	60	22	75	97	
Moorhead	1926	51	13	63	76	
Stumpf	1926	not given			90	
Sanger	1926	50				
Goiter-Exopth.			6	82	88	
Webster	1926	107			82	
Stevens	1926	100			75	
Grier	1927	98	12	55	67	17 patients stopped treatment before sufficient treatment was given. These are counted with failures and reduce percentage
		86 (reported)				
Barclay and Fellows	1927	300	25	63.3	88.3	5 per cent no improvement 6.6 per cent not traced
Holzknicht	1928	not given	20-30	60	80-90	
Meyer	1928	328	18	66	84	
		263 Graves' disease				
Groover, et al	1929	305	8.5	88.8	97.3	2.6 per cent unimproved; 1.3 per cent recurrences; 8.5 per cent cases were postoperative recurrences; 2 per cent telangi- ectasis; 1.3 per cent subsequent hypothyroidism
Pfahler and Vastine	1929	326	30.5	57.5	88.0	Cures average over 6 yrs. 25 cases unknown

twice daily for three weeks following treat-  
ment in an effort to avoid skin damage.  
The patient is given a printed slip caution-  
ing against sunburn or irritating salves  
and lotions.

#### SUMMARY OF RESULTS OF ROENTGEN THER- APY IN HYPERTHYROIDISM

We have treated 327 cases of hyper-  
thyroidism, in 25 of which the subsequent  
result is unknown after one or two treat-

ments. Of the remainder there are 173, or 57.5 per cent, definitely cured for an average of over six years. Ninety-two cases, or 30.5 per cent, are markedly improved and 36 cases, or 12 per cent, are only slightly improved or without improvement at all. Of this series, 25 required subsequent surgical removal of the goiters either because of failure to obtain a response with irradiation or because of a small remaining adenoma.

There were 2 post-irradiation recurrences. This is 0.7 per cent of all cases, or 0.75 per cent of the cases cured or markedly improved. In 4 cases, or 1.3 per cent, the metabolic rate was subsequently less than normal. In only one of these patients is thyroid extract now necessary to relieve symptoms. In 14 cases there were degenerative skin changes such as dryness and telangiectasis. Tanning was not infrequently seen but this usually disappears and is of no significance. Twenty-two of our cases were postoperative recurrences, of which 17, or 77.5 per cent, were either cured or markedly improved and 5, or 22.5 per cent, were not improved.

In 12 cases definite substernal goiters could be recognized. This does not include the numerous low cervical goiters in which the lower border extended slightly beneath the sternum. Of these 12 cases a disappearance was effected in

5, or 45.5 per cent, decrease in size in one, or 9.0 per cent. No change was seen in 5, or 45.5 per cent. The result in one case is unknown.

Our results, obtained by a technique which is now fairly standard, correspond quite closely with those obtained by other roentgenologists, as shown in Table IX. This includes over 3300 cases of which an average of 85 to 90 per cent have been cured or markedly improved. For fear of overlapping, this table does not include the 1788 cases gathered from the literature by Krause, nor the review of over 5000 cases gathered from the literature by Soiland.

#### CONCLUSIONS

Our observations and those of other roentgenologists in treating rather large series of cases of hyperthyroidism permit us to conclude that roentgen therapy offers as great prospects of cure or marked improvement as can be obtained by any other known means. In cases causing pressure or embarrassment of respiration, surgery is indicated. In non-toxic cases, we recommend surgical or medical treatment depending upon the type. When medical treatment fails and surgery is refused, these non-toxic cases may be given several small series of treatments, with little danger of impairment of the normal function of the gland.

#### REFERENCES

1. ALLISON, R. G. X-ray treatment of thyrotoxicosis. *Radiology*, 1925, 4, 470-472.
2. BARCLAY, A. E. Hyperthyroidism. *Radiology*, 1926, 6, 14-22.
3. BARCLAY, A. E., and FELLOWS, F. M. Hyperthyroidism treated by x-rays, a record of 300 private cases. *Brit. J. Radiol.*, 1927, 32, 252-256.
4. BIRCHER, E. Experimental research on Basedow's disease. *Schweiz. med. Wchnschr.*, 1924, 54, 54.
5. BORAK, J. Roentgen therapy and organotherapy in endocrine diseases. *Strahlentherapie*, 1925, 20, 232-267.
6. BORAK, J. The present status of roentgen therapy of Basedow's disease. *Strahlentherapie*, 1926, 23, 519-527.
7. BORAK, J. Neues zur Strahlentherapie bei hyperthyreotischen Erkrankungen. *Röntgenpraxis*, 1929, 1, 145-163.
8. BOWER, J. O., and CLARK, J. H. The resistance of the thyroid gland to the action of radium rays. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1923, 10, 632-643.
9. BRAM, I. Diagnostic methods in exophthalmic goiter, with special reference to quinine. *Med. Rec.*, 1920, 98, 887.

11. CHRISTIE, A. C. A comparison of the results of surgical and roentgen-ray treatment of exophthalmic goiter. *Radiology*, 1925, 4, 464-469.
12. COLE, W. H., and WOMACK, N. A. Reaction of the thyroid gland to infections in other parts of the body. *J. Am. M. Ass.*, 1929, 92, 453-457.
13. CROTTI, A. The Thyroid and Thymus. Lea and Febiger, Philadelphia, 1918.
14. CURSCHMANN, H. Transformation of Basedow's disease into myxedema after roentgen treatment. *München. med. Wchnschr.*, 1925, 72, 1453-1455.
15. CURSCHMANN, H. Zur Therapie des otogenen Schwindels. *Klin. Wchnschr.*, 1928, 7, 941-942.
16. DINSMORE, R. S. Hyperthyroidism in children. *Surg., Gynec. & Obst.*, 1926, 42, 172-176.
17. DINSMORE, R. S. The care of the handicapped goiter patient. *Surg., Gynec. & Obst.*, 1926, 42, 177-179.
18. ELSE, J. E. Classification of goiter. *Med. Sentinel*, 1925, 33, 479-491.
19. ERSKINE, A. W. X-ray therapy in functional thyroid disease. *Radiology*, 1927, 8, 140-141.
20. FALTA. Die Erkrankungen der Blutdrüsen. Springer, Berlin, 1928.
21. FINTON, W. L., and SHAEFFER, A. M. A goiter resumé. *J. Mich. M. Soc.*, 1926, 25, 338-341.
22. FISCHER, J. F. The roentgen treatment of morbus Basedowii. *Acta radiol.*, 1921-1922, 1, 179-206.
23. FRIED, CARL. Die Röntgentherapie der Basedowschen Krankheit. *Klin. Wchnschr.*, 1928, 7, 1648-1651.
24. GOETTE, K. Injury following irradiation in Basedow's disease. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1929, 39, 111-113.
25. GRAHAM, A. Exophthalmic goiter and toxic adenoma. *J. Am. M. Ass.*, 1926, 87, 628-631.
26. GRIER, G. W. X-ray treatment of goiter. *Ann. Int. Med.*, 1927, 1, 241-246.
27. GRIER, G. W. Is irradiation a satisfactory treatment for substernal goiter? *AM. J. ROENTGENOL. & RAD. THERAPY*, 1925, 13, 327-330.
28. GROOVER, THOMAS A. Woody thyroiditis; Reidel's struma. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1925, 13, 466.
29. GROOVER, T. A., CHRISTIE, A. C., MERRITT, E. A., COE, F. O., and McPEAK, E. M. Roentgen irradiation in the treatment of hyperthyroidism. *J. Am. M. Ass.*, 1929, 92, 1730-1734.
30. HARDMAN, T. G. Discussion on "The x-ray treatment of exophthalmic goitre." *Lancet*, 1926, 1, 812-814.
31. HAYES, MAURICE. Discussion on "The x-ray treatment of exophthalmic goitre." *Lancet*, 1926, 1, 812-814.
32. HEIMAN, H. Exophthalmic goiter in childhood, with some unusual manifestations. *Am. J. Dis. Child.*, 1923, 26, 216-222.
33. HELMHOLZ, H. F. Exophthalmic goiter in childhood. *J. Am. M. Ass.*, 1926, 87, 157-162.
34. HERTZLER, A. E. Pathogenesis of goiter considered as one continuous disease process. *Arch. Surg.*, 1928, 16, 61-78.
35. HOLMES, G. W., and MEANS, J. H. Roentgen-ray treatment of toxic goiter. *Arch. Int. Med.*, 1923, 31, 303-341.
36. HOLZKNECHT, G. On the roentgen therapy of Basedow's disease. *Strahlentherapie*, 1928, 30, 605-612.
37. HOLZKNECHT, G. Mild irradiation. *Strahlentherapie*, 1927, 24, 722-727.
38. HUNTER, OSCAR B. Pathology of hyperthyroidism. Meeting of Eastern Radiologists, Washington, D. C., February, 1929.
39. HURXTHAL, L. M. Heart failure and hyperthyroidism. *Am. Heart J.*, 1928, 4, 103-108.
40. JENKINSON, E. L. Thyroid disease. *Radiology*, 1925, 4, 453-457.
41. KHOOR, O. Hyperthyroidism cured by castration. *Zentralbl. f. Gynäk.*, 1926, 50, 343-345.
42. KIMBALL, O. P. Induced hyperthyroidism. *J. Am. M. Ass.*, 1925, 85, 1709-1710.
43. KIMBALL, O. P. The medical aspects of hyperthyroid conditions. *Ann. Clin. Med.*, 1926, 4, 900-906.
44. KRAUSE, Paul. The roentgen therapy of Basedow's disease. *Strahlentherapie*, 1927, 27, 393-412.
45. LAHEY CLINIC. See Ref. 80.
46. LINDENBERG, F. Coincidence of fibroid tumor and exophthalmic goiter, with report of case cured by x-ray castration. *Am. J. Obst. & Gynec.*, 1928, 16, 425-427.
47. MARINE, D. The present status of functions of thyroid gland. *Physiol. Rev.*, 1922, 3, 521.
48. MARINE, D. The importance of our knowledge of thyroid physiology in the control of thyroid diseases. *Arch. Int. Med.*, 1923, 32, 811-827.
49. McCARRISON, R. The experimental production of a new type of goiter unrelated in its origin to iodine. *Lancet*, 1927, 1, 916-920.
50. McGRAW, A. B. Juvenile exophthalmic goiter. *Surg., Gynec. & Obst.*, 1928, 47, 25-31.
51. McLEAN, N. J. Intra-thoracic goiter. *Minnesota Med.*, 1928, 11, 286-291.
52. McLEAN, N. J. Observation on the treatment of goiter. *Illinois M. J.*, 1925, 47, 354-358.
53. MEYER, W. H. Roentgen therapy in hyperthyroidism; a report of 328 cases of thyrotoxicosis subjected to x-ray treatment. *Med. J. & Rec.*, 1928, 127, 137-141.



54. MOORHEAD, T. G. Discussion on "The x-ray treatment of exophthalmic goitre." *Lancet*, 1926, 1, 812-814.
55. MØLLER, EGGERT. Clinical investigations into the basal metabolism in diseases of the thyroid gland. *Acta. med. scand., Suppl.* 21, 1927, p. 21.
56. PEMBERTON, J. DE J. End-results of surgery of the thyroid gland. *Arch. Surg.*, 1923, 7, 37-46.
57. PEMBERTON, J. DE J. Technical difficulties of surgery of the thyroid. *Surg. Clin. N. Am.*, 1925, 5, 743-752.
58. PFAHLER, G. E., and THRUSH, M. C. Exophthalmic goiter treated by roentgen rays. *Therap. Gaz.*, 1906, 22, 179.
59. PFAHLER, G. E. Summary of the results obtained by the x-ray treatment of exophthalmic goitre. *N. York M. J.*, 1908, 88, 781-783.
60. PFAHLER, G. E., and ZULICK, J. D. The treatment of exophthalmic goiter by means of the roentgen ray. *AM. J. ROENTGENOL.*, 1916, 3, 63.
61. PFAHLER, G. E. New roentgenographic technique for the study of the thyroid. *AM. J. ROENTGENOL.*, 1921, 8, 81.
62. PFAHLER, G. E. The treatment of hyperthyroidism by the roentgen rays. *Am. J. Electroth. & Radiol.*, June, 1924.
63. PHILIPPON, H., GOUIN, J., and BIENVENUE, A. A case of exophthalmic goiter; its treatment by sympathetic functional roentgen therapy. *Bull. et mém. Soc. méd. de hôp. de Par.*, 1927, 51, 802-805.
64. PORDES, FRITZ. The oligosymptomatic thyrotoxicoses and their treatment by roentgen rays. *Strahlentherapie*, 1928, 30, 619-633.
65. READ, J. M. Roentgen-ray therapy in thyrotoxicosis; its effect as measured by basal metabolic rate. *Calif. State J. M.*, 1924, 22, 10-15.
66. READ, J. M. Management of exophthalmic goiter. *J. Am. M. Ass.*, 1924, 83, 1963-1968.
67. READ, J. M. Prognosis in exophthalmic goiter. *Am. J. M. Sc.*, 1926, 171, 227-239.
68. READ, J. M. Graves' disease. *J. Am. M. Ass.*, 1927, 88, 1697-1699.
69. ROSE, EDWARD. The treatment of hyperthyroidism. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1928, 19, 546-551.
70. ROWE, E. W. The x-ray treatment of goiter. *Nebraska M. J.*, 1926, 11, 419-422.
71. SAJOUS, C. E. DE M. The medical aspect of goiter. *Weekly Roster and Medical Roster*, Dec. 11, 1926.
72. SABERTON, C. W. S. The x-ray treatment of hyperthyroidism. *Brit. M. J.*, 1924, 1, 661-662.
73. SANGER, B. J. Exophthalmic goiter; a follow-up study of cases treated with the roentgen ray. *Arch. Int. Med.*, 1926, 37, 627-640.
74. SCHWARZ, G. The roentgen therapy of Basedow's disease. *Strahlentherapie*, 1928, 30, 613-618.
75. SHAW, A. F. B., and SMITH, R. P. Riedel's chronic thyroiditis; with a report of 6 cases and contribution to the pathology. *Brit. J. Surg.*, 1925, 13, 93-108.
76. SIELMANN, R. Roentgen therapy in exophthalmic goiter. *Strahlentherapie*, 1923, 15, 450-457.
77. SIELMANN. The radiation therapy of hyperthyroidism. *München. med. Wchnschr.*, 1926, 73, 439-441.
78. SIMPSON, C. A. X-ray treatment of hyperthyroidism and toxic goiter. *Radiology*, 1924, 3, 427-431.
79. SKINNER, E. H., and LOCKWOOD, I. H. The radiotherapy of goiter. *J. Missouri M. Ass.*, 1926, 23, 11-13.
80. SMITH, L., CLUTE, H. M., and STRIEDER, J. W. Results in one hundred consecutive cases of hyperthyroidism operated upon. *Surg., Gynec. & Obst.*, 1928, 46, 325-331.
81. SOILAND, A., COSTLOW, W. E., and MELAND, O. N. Radiation therapy in hyperthyroidism. *Calif. & West. Med.*, 1927, 27, 789-792.
82. STAHNKE, E. The histological and clinical findings in struma in children in lower Franconia. *Arch. f. klin. Chir.*, 1923, 125, 193-230.
83. STEVENS, J. T. Toxic goiter; its treatment by means of radium and roentgen rays. *Radiology*, 1926, 6, 7-13.
84. STEVENS, J. T. Toxic goiter; its diagnosis and treatment with special reference to roentgen and radium treatment. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1928, 19, 539-545.
85. WALTON, A. J. The treatment of exophthalmic goiter. *Brit. M. J.*, 1928, 1, 83-86.
86. WEBSTER, J. H. D. Radiation treatment in exophthalmic goiter. *Brit. M. J.*, 1926, 1, 985-986.
87. WILLIUS, F. A. The heart in thyroid disease. *Ann. Clin. Med.*, 1923, 1, 269.

## DISCUSSION

DR. T. A. GROOVER, Washington, D. C. I wish to congratulate Dr. Pfahler and Dr. Vastine upon the presentation of their statistics in the treatment of hyperthyroidism. That

is exactly what we need to establish this method of treatment upon a firm basis. As you well know, the surgeons have accumulated very large statistics with respect to the surg-

ical treatment of goiter in comparison with which the statistics of the roentgenologists are comparatively meager. Like Dr. Pfahler, I have been interested in this subject for a good many years, and recently when we analyzed our cases and published the results in the *Journal of the American Medical Association*, they paralleled very closely those of Dr. Pfahler. There are, it is true, minor differences in the figures which are very readily reconciled when taken into consideration with the text of the two articles. For instance, I feel sure that we included in our statistics of cures some cases which Dr. Pfahler and Dr. Vastine included as improved. In considering the cure, we took into consideration the relief of evidences of toxic manifestations such as elevation of metabolism and the usual clinical symptoms which go along with thyroid intoxication. Of course many of these patients have had damage to the myocardium or other visceral changes which remain after the thyroid intoxication is completely relieved.

It has been important, too, to establish the permanence of cure from roentgen therapy, as that has been so frequently denied. For many years we have made it a practice never to discharge a patient whom we have treated for hyperthyroidism and the result has been that we have been able to keep most of our cases under observation for a prolonged period of time. Dr. Pfahler has done the same thing, so I know we can state with reasonable certainty that the cure of hyperthyroidism by roentgen treatment is at least as permanent as it is by surgery.

It is quite true that there will perhaps always be a small residue of cases that will not be cured by any treatment, either x-ray or surgery, but certainly there will be quite as many recurrences and failures following surgical treatment as there are following roentgen treatment.

One of the most important criteria for judging the cure of hyperthyroidism is the weight curve. It is important because it is the one criterion about which there can be no argument as to accuracy. In going over our cases, we were struck with the consistent gain in weight of these patients. There was an average gain in our series of cases of  $16\frac{1}{2}$  pounds per patient. I consider that perhaps even of more significance and importance than I do the basal metabolism. I feel sometimes that undue signifi-

ficance is attached to the basal metabolic rate as contrasted with the clinical manifestations of the disease. Certainly the two ought to be correlated, and neither disregarded. I think that sometimes patients with a reported increased basal metabolism or a reported normal metabolism, as the case may be, are treated or dismissed without proper clinical consideration. We do know that there is a great chance for error in the determination of basal metabolism. For instance, I have had patients examined by a number of different physicians on successive days as to the basal metabolic rate, with very wide variation in the results, and while I consider the basal metabolism of importance, I consider the careful clinical evaluation of the signs of thyroid intoxication of a great deal more importance.

I want to add only one more word. I consider that the medical supervision and management of these patients in conjunction with the roentgen treatment is of inestimable importance. If these patients are very toxic, we insist on their going to bed. It is also important to eliminate as far as possible any foci of infection, such as abscessed teeth or diseased tonsils, which ought to be eradicated as far as possible, always giving consideration to the hazard which any sort of an operative procedure entails in these patients. However, I have about reached the conclusion that when a patient is referred to us for the treatment of hyperthyroidism and does not respond in a satisfactory manner, I have overlooked some important contributing factor and by working a little harder to find out what that contributing factor might be, we can frequently turn an apparent failure into a complete success. For instance, in a recent case which had not responded as satisfactorily as it should, we found that we had overlooked careful attention to the mouth, and when several abscessed teeth were removed, the patient went ahead and got entirely well.

Rest and general hygienic management, psychic and otherwise, are of the greatest importance, and I believe that if we pay close attention to all of these contributory factors, we can materially increase our percentage of complete cures.

DR. PFAHLER (closing). I want to thank Dr. Groover for his excellent discussion. Some of the points emphasized by him are brought

out in the paper but were not presented because of lack of time.

In treating a hyperthyroid case, we must not forget that the patient may have associated heart disease or some other associated disease and we cannot expect that just because we treat the patient's thyroid and perhaps get rid of the toxic symptoms that we are also curing every other symptom from which the patient is

suffering. An appropriate treatment must be given for whatever other condition the patient is suffering from. That is often forgotten, especially by specialists in any line of practice. They seem to think that the particular thing that they do, and sometimes the patients think that the particular thing that the specialist does, should relieve every symptom and every complaint.



## THE TREATMENT OF CARCINOMA OF THE BODY OF THE UTERUS\*

By WILLIAM NEILL, JR., M.D.

BALTIMORE, MARYLAND

**A**DENOCARCINOMA of the body of the uterus is rarer than cervical cancer, grows more slowly, and tends to remain restricted to its primary corporal origin. Metastases to distant or neighboring structures, however, are more common than in the cervical group. The ratio in our clinic is 1 to 14, while in the Gynecological Department at Johns Hopkins it is approximately 1 to 35.

It is my present purpose to emphasize our treatment of this disease with radium, reporting results and the percentage of five year cures.

The cause, as in cancer elsewhere, is unknown, chronic irritation apparently playing a less important part than in cervical cancer. There is no evidence that heredity plays a rôle. It is an affliction of later life. In 163 cases seen at the Howard A. Kelly Hospital, the average age was fifty-five, the oldest being eighty and the youngest twenty-eight. In a group of 333 at the Mayo Clinic, Stacy found 10 per cent under the age of forty-five. In our series, 11 per cent were under this age.

I have been unable to find available statistics as to the influence of race on this type of cancer. Lee states that cancer of the uterus, or elsewhere, is seldom, if ever, found in a full-blooded American Indian. Cancer in the Mongolian is known to be very commonly located in the pelvis. We see a large number of negroes at our clinic but find only two in our entire group of 163, while cervical cancer is more prevalent among the negro than in the white race.

It seems to be pretty generally accepted that myoma is a frequent complication. In our series, fibroids appeared in but 12 per cent, and the preponderance of the impacted type was no greater than of the

freely movable. Stacy, in 269 cases where hysterectomy was performed, reports fibroids in 33 per cent; while Norris and Vogt found 21 per cent. Ewing, quoting Kolb, states that 50 per cent of all women over the age of fifty have fibroids, and that 20 per cent of all over thirty-five are so afflicted. Uterine fibroids are notably more common in the negro than in the white, while body cancer is rarer.

In the early development of cancer of the body of the uterus, the predominant symptoms are leucorrheal or watery discharge and bleeding. Severe hemorrhage is rare. Such initial symptoms, present for months without pain or discomfort, lead the patient to believe that there is no serious trouble, and so delays her appeal to the doctor until the characteristic disturbances of the later stages of the disease are becoming apparent. Excessive menstruation is usually the rule in the premenopausal stages; the vast majority, however, occur after the climateric. The same symptoms are common to a variety of diseases, such as polypoid endometrium, polypi, submucous fibroids, vaginitis, and inflammatory conditions.

An accurate diagnosis is easily made by due attention to the history, coupled with a physical exploration. Inspection and bimanual palpation easily differentiate conditions of the vaginal wall arising from the cervix; but vaginal metastasis from a carcinoma of the body of the uterus is common and the disease above may be overlooked. A roentgen examination of the chest is routine in each case. It is impossible to place too much emphasis on the importance of curettage and microscopic study of the tissue removed. In our clinic, no cancer of the body of the uterus has

\* Read at the Fifteenth Annual Meeting, American Radium Society, Detroit, Mich., June 23-24, 1930.



escaped recognition, so far as we know. Occasional cases sent in and diagnosed elsewhere as malignant, without microscopic examination, have proved to be benign. Serious infection has not followed the instrumentation necessary for microscopic examination and there is no evidence that it has precipitated a spread of the disease; and the diagnosis as well as the grade of malignancy is definitely established. Grades 2 and 3 are commoner, following Broders' classification. Of 126 accurately graded, 18 were grade 1, 41 grade 2, 34 grade 3, and 24 grade 4.

For convenience, the cases have been divided into early operable, borderline inoperable, the recurrent after operation, and the metastatic.

When the disease is limited to the uterus, there are two possible methods of successful treatment: a radical operation, as recommended by surgeons the world over, and radium. Operation is safe and satisfactory, and is preferable, in the absence of any well-defined contraindication—especially as one cannot always determine whether or not the disease has extended through the walls of the uterus to the peritoneum. In our series of 27 cases the mortality by abdominal hysterectomy was 9 per cent. Stacy, in a series of 239 cases from the Mayo Clinic, reports a mortality of 6 per cent. The general average from the literature is quoted to be from 6 to 15 per cent.

Recently, Stacy, Heyman, and others, have reported results in treating early cases with radium alone, which indicate the possibilities of this agent. Heyman, in particular, records a five year cure rate equaling that obtained by surgery, but still feels that, in the absence of complications, operation is the method of choice.

In the remaining more advanced groups there is little to be expected from surgery alone, but there still is a definite hope for prolonged palliation, and even a definite cure, with radium.

#### TECHNIQUE OF IRRADIATION

Our main reliance is on intrauterine treatment. There has been no mortality or serious complication. The radiation is from radon, contained in a glass bulb, surrounded by 1 mm. of brass and 2 mm. of rubber so that only gamma rays are emitted. From 1 to 2 curies, contained in from 4 to 6 tubes, are employed. Strings are attached to these and they are inserted into the uterine cavity so as to thoroughly cover the entire canal. From 2000 to 2500 mc-hr. is given in a single dose. This is given under a light anesthetic, preceded by a thorough exploration of the uterine cavity with both sound and polyp forceps. On completion of the treatment, the patient is kept in the hospital for three or four days, and then is given instructions to rest in bed for one week upon returning home. Aside from nausea and malaise, rarely lasting over forty-eight hours, there are, as a rule, no other discomforts. After three months, a second curettage is done and no treatment is given if the tissue is negative. If there is still evidence of malignancy, the question of further irradiation or operation is decided upon. Roentgen irradiation to the iliac glands and pelvic wall supplements this treatment. The roentgen treatment should be given with exactness, for there is a definite danger of injury to the intestines when combined with the heavy intrauterine exposure.

In the extensive inoperable and metastatic group, the treatment varies with the individual patient. Treatment is mostly by crossfire surface irradiation, best given with the roentgen ray unless several grams of radium are available.

The irradiation of postoperative cases should be carried out with great care. Often a loop of bowel will adhere to the vaginal scar, and application directly to the vaginal vault should be mild, the lower vaginal cavity, where metastasis often occurs, receiving the heavier dosage. Otherwise, the treatment is by surface

application as mentioned above. Frequent follow-up examinations are carried out.

#### RESULTS OF TREATMENT

From the literature, I could obtain but few definite data as to the percentage of five year cures in carcinoma of the body of the uterus. Heyman, collecting the results from a number of clinics, reports 58 per cent in 323 operations. By radium alone, he reports 50 per cent five year cures in 52 cases. Clark reports 42 per cent and Norris 44 per cent three year cures by operation. Stacy, in 215 cases, reports 50 per cent four year cures by operation, and in 25 cases treated by radium alone all but 2 have died of the disease within five years.

Our own cases are reported by groups, the first being *operative or early*. Here a subdivision into operation alone, radium alone, and operation and radium combined, is made. As stated above, it has been our practice in the past, when the patient's condition permitted, to treat by operation alone, or combined with radiation. Those treated by radium alone presented definite symptomatic complications which made surgery hazardous. The majority of these complications were old age, corpulence, high blood pressure, cardionephritis, and diabetes. Two patients were normal otherwise physically but refused operation; 11 were treated by operation alone, 46 by radium alone, and 16 by radium and operation.

Of the 11 cases treated by operation alone, 3 are living and well for over five years; 5 are living for less than five years and while free from symptoms are still under observation; one died from the operation; one from a recurrence of the disease; and one was lost sight of—making the operative cure rate 50 per cent.

Of the 46 cases treated by radium alone, 19 have been under observation less than five years and will not be counted in this estimation. Of the remaining 27, treated five years ago or longer, 15 are living and well; 7 died of the disease, and 5 from condi-

tions not related to the original complaint. Of the 15 alive and well, 5 have lived for over five years; one for six years; one for seven years; one for eight years; 4 for nine years; 2 for ten years; and one for twelve years. Of those dying of the disease, all developed metastases. One lived for one year; 2 for two years; 2 for three years; and one lived for seven years after the treatment but ultimately died of the disease. This gives a five year cure rate of 55 per cent. If we included those known to have died from diseases other than cancer, the percentage, naturally, would be higher.

Of the 16 cases treated by a combination of operation and radium, 3 have been treated less than five years and will not be counted. Of the remaining 13, 9 are alive and well after five years. One of these, however, had a recurrence which cleared up with subsequent radium treatment; 2 died of recurrence and one died from the operation. The other case was lost sight of, a percentage of 69.

*Advanced Inoperable Cases.* A large number of these were given only palliative treatment. Omitting 15 treated less than five years, there remain 31 of these cases. Four have been lost sight of; 16 died in less than two years, 3 in less than three years; and 3 in less than four years. One patient lived five years, dying of the disease. Four are living and well after five years. This gives a five year cure rate for this group of 13 per cent.

*Recurrent After Operation.* This group comprises 30 cases; 6 were lost sight of; 20 died of the disease within two years; one has been living and well for three years. Of those cured, one has been living six years; one for seven years; and one for nine years. This gives a five year cure rate of 12 per cent.

*Advanced Cases With Metastases When First Seen.* There are 11 cases in this group. There were no cures. All were in the advanced stages and in none was the attempt made to treat the entire disease, but only to relieve the main complaint—pain. Some

we were able to make more comfortable but none lived over two years.

## COMMENT

Taking all groups treated at the clinic prior to five years ago, there were 109 cases; 76 have died—counting the 6 cases lost sight of as dead—and 33 are living, making a total five year cure rate of 33 per cent.

This study has not attempted a prognosis from the standpoint of histological grading. We have observed extensive metastases in cases classified as grade 1, and some of the cases in grade 4 have remained local for a long time. I know this to be

true also in carcinoma of the cervix and in tumors of the bladder.

## CONCLUSIONS

As with cancer elsewhere, the greatest hope for cure lies in an early diagnosis.

In operable carcinoma of the body of the uterus, radium offers a method of treatment comparable to surgery. It obviates the primary mortality and can be used safely in those presenting bad surgical risks.

Radium offers the possibility of a cure and definite palliation to a number of inoperable and recurrent cases.

When there is any doubt as to the extent of the disease, operation alone or combined with radium is the treatment of choice.

## REFERENCES

1. CLARK, J. G., and BLOCK, F. B. Relative values of irradiation and radical hysterectomy for cancer of the cervix. *Am. J. Obst. & Gynec.*, 1924, 7, 543-549.
2. EWING, JAMES, Neoplastic Diseases. Second edition. W. B. Saunders, Philadelphia, 1922.
3. HEYMAN, J. Radiology as a complete or partial substitute for surgery in the treatment of cancer of the female pelvic organs. *Surg., Gynec. & Obst.*, 1930, 50, 173-183.
4. LEE, B. J. Incidence of cancer among Indians in the Southwest. *Surg., Gynec. & Obst.*, 1930, 50, 196-199.
5. NORRIS, C. C., and VOGT, M. Carcinoma of the body of the uterus. *Am. J. Obst. & Gynec.*, 1924, 7, 550-566.
6. STACY, L. J. Treatment of carcinoma of the body of the uterus. *Radiology*, 1925, 5, 331-338. Carcinoma of the fundus of the uterus. *Surg., Gynec. & Obst.*, 1929, 49, 43-47.

## DISCUSSION

DR. WILLIAM P. HEALY, New York City. This is a splendid and very unusual report. It indicates end-results in a field of cancer where various methods of therapy have been carried out, and we know in each individual instance well carried out, whether it was by operation alone, where the surgery was done by the best technique, or by radium alone or a combination of both methods. The patients were in the hands of experts at all times. Therefore, we must assume that these figures represent probably the best figures that could be obtained for the treatment of this type of cancer.

It has been known that radium has had little, if any, value in the treatment of cancer of the corpus uteri, except in the advanced or hopeless cases. My own attitude of mind on the subject until recently can be stated briefly. Most of these patients are beyond the menopause when they come to us and have been free of uterine bleeding for some time. Then they notice bleeding, which we find on examination

is coming from the uterine cavity. The procedure advised in such cases was always diagnostic curettage, and if examination of the material obtained by the curette indicated that we were dealing with cancer of the corpus uteri, we tried always to obtain the patient's permission to proceed at once with abdominal hysterectomy, unless there was some definite contraindication to that procedure. That was our invariable plan until recently, but a year or so ago Dr. Max Cutler and I reviewed a number of our corpus cases that had been treated three to five years previously. We reviewed these cases with an absolutely open mind as we wanted to see if there was anything important in the findings.

We took the lead of Mahle of the Mayo Clinic, who had published a splendid paper, and of Dr. Stacy also, but Mahle had charted his tumors into four histologic groups and we did the same with ours. We found, as he did, that they could be grouped into four classes.

This first group, known as papillary adenoma malignum, grade I, presents a lesion of very low grade malignancy, but nevertheless cancer. We found these cases were very easily cured by curettage in many instances, and when the uterus was removed a few weeks later the pathologist found no evidence of carcinoma. This group can be cured by irradiation, by hysterectomy, or any other available method of procedure.

The second group, known as adenoma malignum, grade II, shows that the gland spaces are more infolding; it is more malignant than the preceding group, but still there is no breaking through of the cells into the stroma. This group is definitely curable by radium applied directly within the uterus, or by hysterectomy.

The third group is known as adenocarcinoma, grade III. Here we have gone definitely further into fully developed adenocarcinoma. There are definite masses of cancer cells through the stroma rather than in the gland structure. This is a very serious disease; much more so than any other group we have in cancer of the corpus uteri. No matter how it is treated, according to our studies, whether by hysterectomy, radium, or a combination of these, the results are disappointing.

The fourth group is known as anaplastic adenocarcinoma, grade IV, and is a very malignant carcinoma arising from the glands. It is exactly, under the microscope, like the anaplastic growth of the cervix. This type responds well to radiation therapy. This also shows, according to embryonal cell type, the most malignant type of growth, but it behaves differently to radiation than the third group.

Of the papilloma malignum cases 98 per cent have remained well. In the second group 65 to 70 per cent have remained well for five years. In the third group only 18 per cent have remained well. In the fourth group 6 to 12 cases are still alive, giving us 50 per cent in that group.

The important thing, we think, is that in three different institutions, in different parts of the world, where radiation treatment was carried out on operable cases of cancer of the corpus uteri we have an average of 58.5 per cent cures, which is certainly as good as surgery can show in carcinoma of the corpus uteri.

So, since we found that radiation therapy was apparently very important in the treatment of these cases, and since we found there was an anaplastic type of cancer originating in this region, we have changed our treatment in these groups to the application of radium followed by high voltage roentgen rays, and then in five or six weeks we do an abdominal hysterectomy. We have been doing this for one year in all cases in which operation was not absolutely contraindicated. During this period it has been amazing to us to note how frequently when we remove the uterus six weeks after the irradiation the pathologist has found no carcinoma. It seems to have been cleared up with the treatment. As a rule, we never give over 3,600 or a maximum of 4,000 milligram-hours within the uterus plus the high voltage cycle, and then in six weeks do the hysterectomy.

I think the field for irradiation in cancer of the corpus uteri is better than we realized, but I believe cancer of the corpus has to be regarded as primarily and largely a surgical disease. I would not wish to omit hysterectomy from our therapeutic procedure, certainly not in the third and fourth groups. I would be willing to omit it in selected cases in the second group, and would omit it completely in the first group.

DR. LEDA J. STACY, Rochester, Minn. In the paper which I read two and a half years ago I noted that those patients in whom the carcinoma of the fundus was associated with fibroids had had symptoms for a longer time than those not having fibroids. This is probably due to the fact that the symptoms were misinterpreted and the metrorrhagia was erroneously thought to be explained by the fibroids. Carcinoma of the fundus occurs more frequently during the menstrual life than it was previously thought as 10.5 per cent of the patients were between the ages of forty-five and forty-nine, and 10.5 per cent were less than forty-five years of age, though in the group reported in the paper quoted by Dr. Neill 63 per cent of the patients had ceased menstruating. The youngest was nineteen years of age. The patient of nineteen years was operated upon nine years ago and is still alive and well.

I wish to correct Dr. Neill in quoting my percentage of five year cures as our statistics show that 63.88 per cent had lived more than



five years following the operation, and of the 288 persons heard from 53 per cent are still living, all more than five years after the operation. Of the 79 patients heard from who had been operated on 15 or more years previously 29 per cent were still living.

The point Dr. Neill brought out about the cases of grade IV carcinoma giving better results is interesting. The same observation was made in reviewing our statistics and I think this may be explained by the fact that in the grade IV cases the growth is proliferative and bleeds more readily, thus producing symptoms which attract the patient's attention earlier than the infiltrating type of growth which may be of considerable extent before producing symptoms.

I was much interested in Dr. Neill's and Dr. Healy's reports regarding the results following radium and roentgen treatments in carcinoma of the fundus uteri. At the Mayo Clinic we operate upon all cases of carcinoma of the fundus of the uterus unless there is definite

contraindication to operation. A number of patients have received roentgen and radium irradiation preliminary to the hysterectomy while being prepared for the operation and in one or two instances carcinoma was not found in the removed uterus.

I think the difficulty one might encounter in treating carcinoma of the fundus with radium would occur especially in those cases in which the carcinoma has developed at the base of a polyp, and it is in this type that one can expect excellent results following the hysterectomy.

DR. NEILL (closing). I wish to thank Dr. Healy and Dr. Stacy for their important discussions. We have not been doing a hysterectomy following irradiation, as has Dr. Healy, but let the radium stand on its merits, being fearful of stirring up some lingering island of inactive disease not detected on palpation. Rectal examination is indispensable in determining the extent of involvement in the lateral structures, it being impossible to estimate this by vaginal examination alone.



## THE DETECTION, ESTIMATION AND ELIMINATION OF RADIUM IN LIVING PERSONS GIVEN RADIUM CHLORIDE INTERNALLY. II.

By HOWARD H. BARKER,  
*United States Radium Corporation,*  
NEW YORK CITY,

and HERMAN SCHLUNDT,  
*Professor of Chemistry, University of Missouri*  
COLUMBIA, MISSOURI

THE elimination of radium introduced into the human body by one of several methods began to command the attention of the medical profession about 1915, and has more recently been studied and discussed as a result of the so-called "radium poisoning" cases.<sup>8,9</sup> The earlier investigations were conducted primarily with regard to the frequency with which radium must be introduced into the system in order to maintain a fixed quantity, and further to develop a type of radium preparation which when once introduced would remain there for a sufficiently long enough period to have some effect. Seil, Viol and Gordon<sup>11</sup> studied the elimination of soluble radium salts taken intravenously and per os by man over periods of five to twenty-one days after administration. They computed the elimination by collecting the feces and urine and determining quantitatively the amount of radium contained, and by knowing definitely the amount originally administered they could calculate the rate of elimination from day to day. They report that from 25 to 35 per cent of the radium taken by mouth remains in the body four or five days after ingestion, while from 55 to 65 per cent of the radium injected intravenously remains after four or five days, and that the rate of elimination in both cases is about the same from that period on. After the tenth day they found the amount eliminated to be less than 1 per cent per day.

In the interim between 1910 and 1913 Dominici and his associates<sup>1-5</sup> published considerable work relative to the fixation and duration of radium salts, both

soluble and insoluble, in the system of animals—a horse and rabbits—when injected intravenously and intramuscularly.

More recently several references have been made to the rate of elimination, but most of them have lacked sufficient experimental data to be convincing. Flinn<sup>6</sup> checked the rate of elimination where radioactive luminous zinc sulphide was fed to guinea pigs, and reports that approximately 98 per cent of the radioactive material was excreted within a few days after the ingestion had ceased. Flinn and Seidlin<sup>7</sup> report rather phenomenal results in the increased rate of elimination among some of the radium cases, with the use of parathormone treatment. Apparently with the administration of parathormone repeated, extending over periods of two to five months, nearly 50 per cent of the radioactive material which had been held fixed in the system for five years or longer was eliminated during the treatment. Since a close connection between calcium and radium elimination is generally assumed, these experiments present an amazing reduction and exchange of calcium compounds in the system, unless one makes the bold assumption that parathormone exercises a specific therapeutic action on radium fixed in the bony skeleton.

Progress has been handicapped because of lack of living subjects for careful study over prolonged periods of time, and the authors, therefore, feel that they have been exceptionally fortunate in having the co-operation of a group of medical men who have for four or five years administered radium chloride internally—that is, either intravenously, intramuscularly or per os.

for it was through their cooperation that we were able to examine and collect the data on the cases herewith reported.

As will be shown later, some of the cases examined were given radium chloride internally four or five years prior to the examination, others one or two years before, while others were being given the material currently at the time of examination.

Naturally, the first object of our examination was to ascertain whether or not radioactivity could be detected in the subjects by electroscopic tests, and at the same time to determine the approximate quantity of radium present. In conducting the tests we followed fairly closely the method described by Schlundt, Barker and Flinn.<sup>10</sup> For the detection of the penetrating radiation we employed the same gamma ray electroscope,—a Wulf-Hess quartz fiber instrument used in our former work. Two new Lind ionization chambers, each of 2700 c.c. volume, and a new electroscope head were used for the detection and estimation of radium in the expired air from the subjects. Since all the instruments employed had been calibrated in terms of radium units our experiments enabled us to express between certain limits the quantity of radium present in each subject found radioactive. In cases where no radioactivity was detected, the tests were negative by both the gamma-ray instrument and the expired air method of detecting radium in living persons.

The experimental data obtained are given in condensed form following the record of doses of radium chloride for each patient. The activity detected by the gamma-ray test, plus the activity of the expired air, represents the total quantity of radium present in the patient at the time the test was conducted. All cases reported were examined Nov. 9 to 10, 1929. The clinical data, as well as doses of radium administered in these cases were supplied by the medical men in attendance, which together with the radioactivity of the patients are summarized in tabular

form. All radium values are expressed in micrograms,  $\mu\text{g.}$  ( $1 \mu\text{g.} = 10^{-6} \text{ g. Ra element}$ ).

#### EXPERIMENTAL PART

CASE I. Female, aged sixty-five, a physician specializing in obstetrics. When first seen in June, 1927, patient had a very bad myocarditis, intermittent heart, diabetes, 10 per cent sugar, 9 pints urine in twenty-four hours, 3 plus acetone and diacetic acid. Radium chloride to be taken orally was prescribed. For approximately four months the patient took 1 dram radium chloride solution daily, containing 3  $\mu\text{g.}$  of radium element. The dosage was then reduced to 1/2 dram daily, which the patient continued taking more or less regularly up to date of examination.

#### DATES AND TYPE OF ADMINISTRATION All Radium was Administered Orally

	1927	1928	1929	
Jan.		100		
Feb.				
Mar.				
Apr.				
May		100		
June	265			
July	270		100	
Aug.	120			
Sept.	200			
Oct.	100	100	100	
Nov.				
Dec.				
Totals	955	300	200	

*Summary*  
1927—955 $\mu\text{g.}$   
1928—300 $\mu\text{g.}$   
1929—200 $\mu\text{g.}$   

---

Total—1455 $\mu\text{g.}$

Radioactivity Nov. 9, 1929 (1.5 $\mu\text{g.}$  radium taken 3 hrs. before test)

By gamma-ray test..... 2-4 $\mu\text{g.}$  radium

By expired air test..... 2.5-4 $\mu\text{g.}$  radium

Total..... 4-8 $\mu\text{g.}$

CASE II. Male, aged fifty-seven, employed as outside salesman. When first seen in August, 1924, there were marked gastric disturbances and epigastric pains. Eighty  $\mu\text{g.}$  of radium element was given intravenously in 10  $\mu\text{g.}$  doses, at five to seven day intervals. At the same time radium was taken orally, and continued after the intravenous treatment.

DATES AND TYPE OF ADMINISTRATION

	1926		1927		
	Oral	Intra.	Oral	Intra.	
June			60		<i>Summary</i> 1926—320 $\mu$ g. 1927—60 $\mu$ g.  Total—380 $\mu$ g.
Aug.	60	50			
Sept.	60	30			
Oct.	60				
Nov.	60				
Totals	240	80	60		

Tests for radioactivity were negative.

CASE III. Female, aged forty-nine, housewife. Patient displayed multiple arthritis and some myocarditic disturbances, as well as intermittent heart. She was given 70  $\mu$ g. of radium element intravenously in 10  $\mu$ g. doses, at five to seven day intervals. Radium chloride was taken orally at the same time and continued after cessation of intravenous treatment.

DATES AND TYPE OF ADMINISTRATION

	1927		1928	
	Intra.	Oral	Oral	
Jan.				<i>Summary</i> 1927—190 $\mu$ g. 1928—60 $\mu$ g.  Total—250 $\mu$ g.
Feb.			20	
Mar.				
Apr.			20	
May			20	
June				
July				
Aug.				
Sept.	40	40		
Oct.	20	40		
Nov.	10	40		
Totals	70	120	60	

The gamma-ray test for radioactivity was negative.

The expired air test showed slightly radioactive, but at best a mere trace.

CASE IV. Male, aged sixty-five, attorney. Patient first came under observation in 1924—had a 4+ Wassermann reaction; hypertension and glycosuria. During 1924 and 1925 was given two series of treatments of 9 gm. neosalvarsan, followed with mercury and bismuth in the usual manner. Wassermann remained 4+. In 1927 the patient received another

course of neosalvarsan, followed with mercury and bismuth, also radium administered intravenously.

DATES AND TYPE OF ADMINISTRATION  
All Radium was Administered Intravenously

	1927	1928	<i>Summary</i> 1927—440 $\mu$ g. 1928—450 $\mu$ g.  Total—890 $\mu$ g.
Feb.	40	200	
Mar.	40	250	
Apr.	50		
May	10		
Nov.	150		
Dec.	150		
Totals	440	450	

*Radioactivity*

By gamma-ray test..... 10-18 $\mu$ g. radium

By expired air test..... 9-15 $\mu$ g. radium

Total..... 19-33 $\mu$ g.

CASE V. Male, aged thirty-eight, accountant. Patient was first seen in 1929, and was a case of dementia praecox. Eighty  $\mu$ g. of radium element in the form of chloride was administered intravenously in 10  $\mu$ g. doses, at five to six day intervals.

DATES AND TYPES OF ADMINISTRATION

	1929 Intravenously
Jan.	
Feb.	50
Mar.	20
Apr.	10
Total	80 $\mu$ g.

Tests for radioactivity were negative.

CASE VI. Male, aged seventy-five, real estate business. Patient had phlebitis of left leg, and intermittent heart, also myocarditis. During 1924, 240  $\mu$ g. of radium element was administered intravenously and orally over a period of approximately four months. Tests for radioactivity were negative.

CASE VII. Male, aged fifty-four, practicing dental surgeon, also M. D. When first seen in fall of 1926, patient had myocarditis, intermittent heart, bad cough and night sweats, also hypotension. A course of radium treatment



was administered intravenously in 1926 and 1927, after which the general condition was much improved, and remained good until the summer of 1929, when there was a recurrence. Another course of radium was administered intravenously—the last dose was given approximately two weeks prior to our examination.

DATES AND TYPE OF ADMINISTRATION  
All Radium Administered Intravenously

	1926	1927	1928	1929	
Jan.				20	<i>Summary</i> 1926—60μg. 1927—110μg. 1928—20μg. 1929—140μg. Total—330μg.
Feb.				30	
May		30		10	
June		10		10	
July		20			
Aug.		10		20	
Sept.				40	
Oct.	10	10		10	
Nov.	40				
Dec.	10	30	20		
Totals	60	110	20	140	

*Radioactivity*

By gamma-ray test..... 5- 8μg. radium  
 By expired air test..... 4- 6μg. radium

Total..... 9-14μg. radium

CASE VIII. Male, aged sixty-six, executive work. Patient was first seen in late summer of 1924. Had bad cardiac asthma. Was given 85 μg. of radium chloride at five day intervals in 10 μg. doses with 25 μg. to start. Another series of radium chloride treatments, administered intravenously, was given in 1929.

DATES AND TYPES OF ADMINISTRATION  
All Radium Administered Intravenously

	1924	1925	1928	1929	
Jan.				20	<i>Summary</i> 1924—85μg. 1925—70μg. 1928—40μg. 1929—110μg. Total—305μg.
Feb.		30		20	
Mar.				10	
Apr.		20		20	
May				10	
June					
July				10	
Aug.	55	20		10	
Sept.	30			10	
Dec.			40		
Totals	85	70	40	110	

*Radioactivity*

By gamma-ray test..... 5- 8μg. radium  
 By expired air test..... 4- 6μg. radium

Total..... 9-14μg. radium

CASE IX. Male, aged thirty, butcher. First seen in May, 1924. Was treated for urethral gonorrhea. Case was given approximately 200 μg. radium element intravenously. Physician in charge died and case was taken over by another physician and radium treatment continued.

DATES AND TYPE OF ADMINISTRATION  
All Radium Administered Intravenously

	1925	1926	1927	1928	
Jan.					<i>Summary</i> 1924—200μg. 1925—240μg. 1926—170μg. 1927—400μg. 1928—120μg. Total—1130μg.
Feb.		60	40		
Mar.		30		60	
Apr.	20		120		
May	40		120		
June	30		120		
July					
Aug.	60				
Sept.	60				
Oct.					
Nov.	30	40			Total—1130μg.
Dec.		40			
Totals	240	170	400	120	

*Radioactivity*

By gamma-ray method..... 5- 9μg. radium  
 By expired air method..... 5- 9μg. radium

Total..... 10-18μg. radium

CASE X. Female, aged forty, clerical worker. Patient was operated on early in 1926 for duodenal ulcers. She became easily fatigued and caught cold readily—hypotension. Was given course of radium chloride treatment, both intravenously and orally.

Table I gives the data and information relative to the various cases in condensed form. All radium values are expressed in terms of micrograms, μg. ( $10^{-6}$  g. Ra element).

From Table I we note that 4 of the 10 cases examined were negative so far as the radioactive tests were concerned, and that one case showed a mere trace. It is, of

DATES AND TYPE OF ADMINISTRATION (CASE X)

	1926		1927	
	Intra.	Oral	Intra.	Oral
Jan.			10	20
Feb.			20	
Mar.			20	20
Apr.			10	
May				
June			10	20
July				
Aug.			20	12
Nov.	15	20		
Dec.	10			
Totals	25	20	90	72

Summary  
 1926—45 $\mu$ g.  
 1927—162 $\mu$ g.  
 Total—207 $\mu$ g.

Tests for radioactivity were negative.

course, impossible to estimate the rate of elimination in these cases, but that the radium administered has been eliminated there is no question.

Cases I, VII and VIII had been given the material so recently prior to our examination that had we not detected the presence of radioactive materials in their systems we would have been surprised. However, considering the quantity of material taken orally by Case I, as well as the fact that she had taken a small amount the day the tests were conducted, it would seem from the small amount found that her rate of elimination must be very high. Cases VII and VIII contain quantities of radium well within the range of what might be expected, based on the work of Seil, Viol and Gordon.

Although nearly two years had elapsed between the last time Cases IV and IX had received radium chloride internally, and the date of our examination, they showed the largest amount of radium in their systems of any of those examined. In this connection, however, it is of interest to note

TABLE I

Case No.	Diagnosis	Ra. Given Orally $\mu$ g.	Ra. Given Intravenously $\mu$ g.	Total Ra. Given $\mu$ g.	Period Since Last Treatment	Ra. Remaining in System $\mu$ g.
I	Myocarditis, intermittent heart, 10% sugar, 3+ acetone and diacetic acid	1455	—	1455	1 day	4-8
II	Gastric disturbances	300	80	380	2½ yrs.	none
III	Multiple arthritis and myocarditis	180	70	250	1½ yrs.	mere trace
IV	4+ Wassermann, hypertension and glycosuria	—	890	890	1½ yrs.	19-33
V	Dementia praecox	—	80	80	7 mos.	none
VI	Phlebitis left leg, myocarditis	120	120	240	5 yrs.	none
VII	Myocarditis, hypotension	—	330	330	2 wks.	9-14
VIII	Cardiac asthma	—	305	305	5 wks.	9-14
IX	Urethral gonorrhea	—	1130	1130	1½ yrs.	10-18
X	Hypotension	92 •	115	207	2 yrs.	none •

that both of these cases had received large amounts of radium chloride internally, 890 and 1130 micrograms respectively, and that it had been given as a last resort to help conditions that had not responded to other types of medication. Case IV had a 4 plus Wassermann reaction and had had two courses of treatment with neosalvarsan, bismuth and mercury prior to the time radium chloride was given, and one course of neosalvarsan, bismuth and mercury concurrently with the radium chloride.

Case IX was considered an incurable case of urethral gonorrhea at the time the radium chloride treatment was started, though practically every known medical remedy had been tried. These two cases are outstanding, and whether or not there may be some connection between their respective conditions and previous treatment given, and the fact that they have retained a fair amount of radium after approximately two years might be worthy of further investigation and consideration.

## REFERENCES

1. DOMINICI, H., and FAURE-BEAULIEU, M. Arrêt et séjour prolongé du sulfate de radium dans les tissus vivants, pendant une durée excédant une année. *Compt. rend. Soc. de biol.*, 1910, 68, 46-48.
2. DOMINICI, H., LABORDE, A. (Mme.), and LABORDE, A. De la fixation, par le squelette, du radium injecté à l'état soluble. *Compt. rend. Soc. de biol.*, 1913, 75, 108-109.
3. DOMINICI, H., PETIT, G., and JABOIN, A. Sur la radioactivité persistante de l'organisme résultant de l'injection intraveineuse d'un sel de radium insoluble et sur ses applications. *Compt. rend. Acad. d. sc.*, 1910, 150, 726-728.
4. DOMINICI, H., PETIT, G., and JABOIN, A. Radioactivité persistante de l'organisme sans l'influence des injections du radium insoluble, sérothérapie radio-active. *Compt. rend. Acad. d. sc.*, 1911, 153, 1509-1511.
5. DOMINICI, H., LABORDE (Mlle. Simone), and LABORDE, A. Étude sur les injections de radium. *Compt. rend. Acad. de sc.*, 1913, 156, 1107-1109.
6. FLINN, F. B. Radioactive material an industrial hazard? *J. Am. M. Ass.*, 1926, 87, 2078-2081.
7. FLINN, F. B., and SEIDLIN, S. M. Parathormone in the treatment of "radium poisoning;" preliminary report. *Johns Hopkins Hosp. Bull.*, 1929, 45, 269-275.
8. MARTLAND, H. S., CONLON, P., and KNEF, J. P. Unrecognized dangers in use and handling of radioactive substances; with especial reference to storage of insoluble products of radium and mesothorium in reticulo-endothelial system. *J. Am. M. Ass.*, 1925, 85, 1769-1776.
9. MARTLAND, H. S. Occupational poisoning in the manufacture of luminous watch dials; general review of hazard caused by ingestion of luminous paint, with especial reference to the New Jersey cases. *J. Am. M. Ass.*, 1929, 92, 466-473; 552-559.
10. SCHLUNDT, H., BARKER, H. H., and FLINN, F. B. Detection and estimation of radium and mesothorium in living persons. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1929, 21, 345-354.
11. SEIL, H. A., VIOL, C. H., and GORDON, M. A. The elimination of soluble radium salts taken intravenously and per os. *N. York M. J.*, 1915, 101, 896-898; also *Radium*, 1915, 5, 40-44.



# THYROGLOSSAL DUCT CYST AND SINUS

## A ROENTGEN STUDY

By PAUL O. SNOKE, M.D.

LANCASTER, PENNSYLVANIA

A GENERAL perusal of the literature on cysts and fistulae of the thyroglossal duct would lead to the conclusion that all fistulae or sinuses in the midline of the neck persisting after attempts at excision were draining from the unexcised thyroglossal duct. Sistrunk<sup>6,7,8</sup> reports successful excisions after coring of the duct but carefully states that "practically 100 per cent should be cured." Jones<sup>2</sup> and Schweizer<sup>5</sup> present two excellent roentgen studies but little else of value is to be found from the roentgenologic standpoint.

Jones suggests the use of gentian violet injection before operation to determine the extent of the sinus, but as every surgeon knows this has its distinct disadvantages. Roentgen study with opaque media offers an excellent field for the determination of the extent of these fistulae and sinuses.

### EMBRYOLOGY

The emphasis laid upon the thyroglossal duct in anatomical, surgical and embryological teaching probably had its origin in the older anatomical works in which only the median thyroid anlage is stressed. Piersol<sup>3</sup> discredits the lateral thyroid anlage conception, but this work was published in 1907, five years before Wenglowksi<sup>9</sup> published his epoch-making embryological studies. Wenglowksi's work firmly establishes the existence of the lateral thyroid anlage and consequently their ducts (Fig. 1). If the median duct persists there is no reason why the lateral ducts should not persist.

We quote excerpts from conclusions 4 and 9 from Christopher's<sup>1</sup> translation of Wenglowksi's article:

4. The branchial apparatus can not leave remnants in the neck below the hyoid.

9. The lateral thyroid lobes also have a short canal which disappears early. By analogy with the thymic duct one can consider that this

canal may also persist and form fistulae and cysts.

The inner opening of such fistulae is found lateral to the entrance of the larynx.

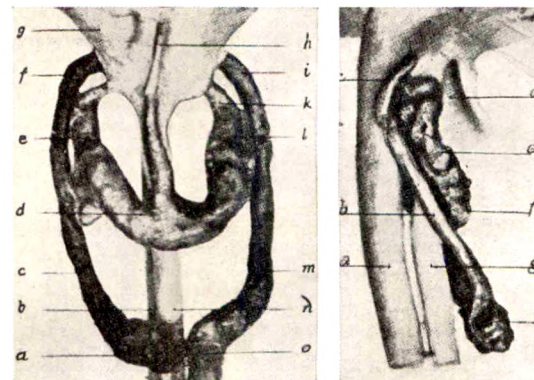


FIG. 1. Reproduction from Wenglowski's models of 14 mm. and 20 mm. embryos: (a) thymus; (b) esophagus; (c) duct of thymus; (d) thyroglossal duct; (e) lateral lobes of thyroid; (f) duct of thymus; (g) pharynx; (h) thyrolingual tract; (i) duct of thymus; (k) duct of lateral lobes of thyroid; (m) duct of thymus; (n) trachea; (o) thymus.

If this is correct then one might expect to find such a case clinically. The case we present suggests this possibility.

### CASE REPORT\*

A. B., aged thirty-four, white, single, female, was perfectly well until fourteen years of age (1909) when she noticed that a swelling developed in the submental and submaxillary region and extended down into the neck whenever she had an acute intraoral infection. Usually this subsided but on one occasion suppuration occurred and incision became necessary. At this time, an attempt to remove the cyst (?) was made and after a prolonged period of drainage the incision healed. Five years later (1914) a small sinus opened at the site of the original incision. Since that time, this sinus has persisted, a period of fourteen years.

\* Reported through the courtesy of Dr. C. P. Stahr and from the X-Ray Department of the Lancaster General Hospital.



On Aug. 19, 1929, another unsuccessful attempt at excision was made, after which the patient was referred to the roentgenologist for such examinations as he thought necessary.

The patient was a well-developed young woman. The intraoral examination was negative. There was a transverse scar  $1\frac{1}{4}$  inches long over the left thyroid cartilage in the center of which was the opening of a sinus, from which a thin mucinous material exuded (Fig. 2). This fluid was examined cytologically and for tubercle bacilli, diphtheria bacilli, actinomyces and salivary ferments, none of which were found. Dental roentgenograms were negative. Intermaxillary bite films were made in an attempt to find salivary calculi but were

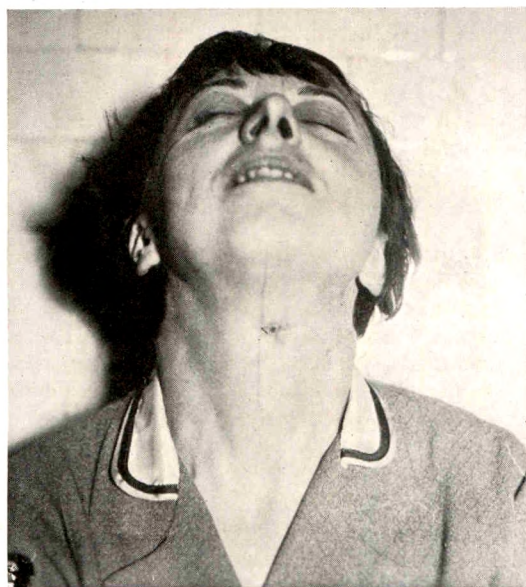


FIG. 2. Note midline drawn in ink on throat. Sinus opens to left over thyroid cartilage.

negative. Roentgen examination of the neck in anteroposterior and lateral positions was negative.

Ordinary attempts to inject the sinus were unsuccessful until Dr. Paul Bishop of the Pennsylvania Hospital suggested inserting a ureteral catheter and using lipiodol. With this technique we were successful. The catheter was inserted 2.5 cm. (Fig. 3). The sinus extended upward to the hyoid bone and after investing it, divided into two tracts, a right and a left, which ran directly posteriorly and then curved upward and anteriorly into the

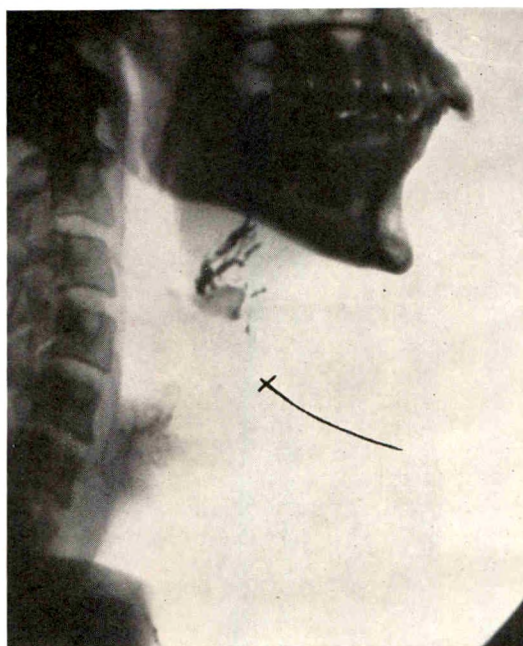


FIG. 3. Curved line represents ureteral catheter; the dash, point of entrance. Note distinct posterior direction of sinuses above hyoid and sharp curve upward and forward.

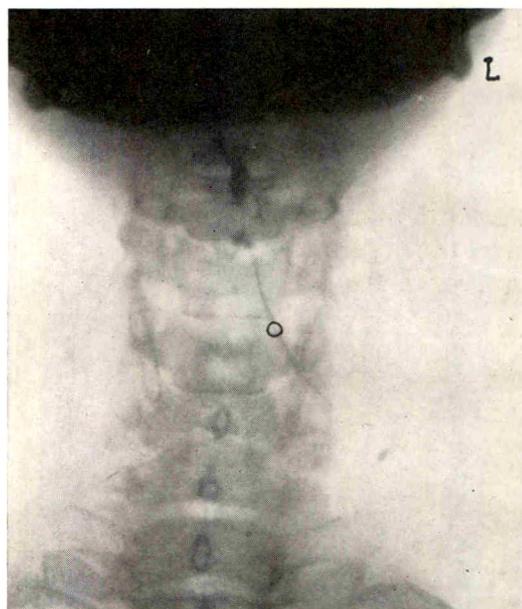


FIG. 4. Ureteral catheter is visible on the left. Circle is point of entrance into sinus. Hyoid bone lies at foot of Y. Left arm indistinct in reproduction.



floor of the mouth (Fig. 4). They did not communicate with the oral cavity as the patient did not taste the lipiodol. They passed in close proximity to both pyriform sinuses at the point Wenglowski concluded they should communicate with the pharynx.

#### COMMENT

The median thyroglossal duct proceeds posteriorly from the hyoid bone at an angle of  $45^\circ$  so that there can be no confusion with this duct (Fig. 5). The conclusion was reached, therefore, that these were lateral thyroid ducts which persisted as they were above the hyoid and united at their junction with the median duct.



FIG. 5. Normal course of thyroglossal duct. Plotted on a normal film.

The course after approximating the supposed embryologic destination is unusual but may be the normal course in the adult. The other possibility is that this was a very large cyst which ruptured, producing numerous ramifications.<sup>4</sup> This would be rather unusual as the sinuses are bilaterally symmetrical.

#### SUMMARY

A case of thyroglossal duct sinus is presented in which the lateral anlage ducts are believed to have persisted rather than the usual median duct.

Roentgen demonstration was made possible by the use of a ureteral catheter and iodized oil.

#### REFERENCES

1. CHRISTOPHER, F. The surgical treatment of lateral cervical fistulae. *Surg., Gynec. & Obst.*, 1924, 38, 329-335.
2. JONES, E. O. Persistent thyroglossal duct. *Surg. Clin. N. Am.*, 1924, 4, 1183-1195.
3. PIERSOL, GEO. A. Human Anatomy. J. B. Lippincott Co., Philadelphia, 1907, p. 1793.
4. PIERSOL, GEO. A. Human Anatomy. J. B. Lippincott Co., Philadelphia, 1907, p. 1829.
5. SCHWEIZER, R. Demonstration eines Röntgenbildes mit offenem Ductus thyroglossus. *Schweiz. med. Wchnschr.*, 1929, 59, 250.
6. SISTRUNK, WALTER E. The surgical treatment of cysts of the thyroglossal tract. *Ann. Surg.*, 1920, 71, 121-122.
7. SISTRUNK, WALTER E. Cysts of the thyroglossal duct. *Minnesota Med.*, 1926, 9, 235-236.
8. SISTRUNK, WALTER E. Technic of removal of cysts and sinuses of the thyroglossal duct. *Surg., Gynec. & Obst.*, 1928, 46, 109-112.
9. WENGLOWSKI, R. Ueber die Halsfisteln und Cysten. *Arch. f. klin. Chir.*, 1912, 98, 151-208.





## SYPHILITIC INFECTION OF THE LUNG\*

### CASE REPORT

By HOWARD J. HUTTER, *Captain, Medical Corps. U. S. A.*

*Roentgenologist, Army and Navy General Hospital*

HOT SPRINGS NATIONAL PARK, ARKANSAS

SYPHILIS is such a protean disease that it is not surprising in its universal attacking of nearly every tissue throughout the body from the skin to the bone to find it manifested in the lungs. The difficulty of actually proving syphilitic infection of the lung in the past has accounted for the apparent rarity of this manifestation, though the probable truth is that syphilis of the lung is not any more unusual than syphilitic lesions involving the brain, the bone or the skin.

### CASE REPORT

T. W. B., colored, aged thirty-two, ex-private, was admitted to the Army and Navy General Hospital, Hot Springs National Park, Arkansas, Jan. 11, 1928. He was a farmer, and had never been out of the United States. He gave a history of chronic malaria which was treated for two or three years, otherwise his family and personal history was irrelevant.

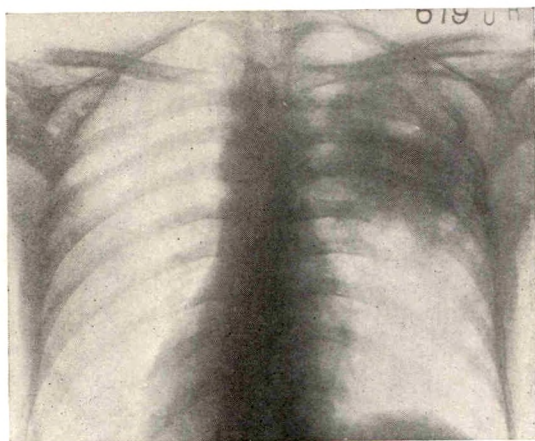


FIG. 1. Jan. 20, 1928. Note the marked consolidation right upper lobe, with central area of rarefaction. Note the destructive processes at the acromial ends of both clavicles. Palpation of this region failed to elicit much tenderness. There was no loss of motion at the shoulder joints.

He contracted syphilis in 1918 while in the Army and had a short course of antiluetic treatment. He also had gonorrhea, urethral, in 1918 and 1926. He had not been treated for

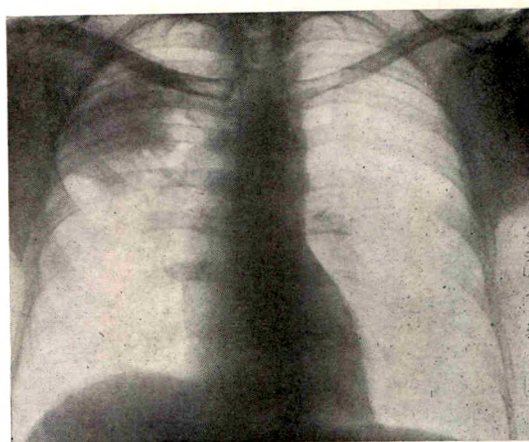


FIG. 2. March 5, 1928. Note how the area of consolidation in the right upper lobe has diminished in size.

syphilis since his discharge from the Army. His chief complaint was pains in the chest, which he said he had had for one and one-half years, with fever, constant coughing of blood, and loss of weight and strength.

Physical examination revealed an ambulatory male, height 65 inches, weight 108 pounds, normal weight 127 pounds, general condition fair. Pupils were equal and reacted to light and accommodation. The skin and mucous membranes, glandular system, and vascular system showed no evident abnormality. Blood pressure: 110/70. The heart was negative. Lungs: Harsh râles were heard in both upper lobes, with dullness and diminished resonance, and many moist râles in the right upper lobe. The genitourinary system showed a scar at the external urinary meatus, which just permitted a No. 18 diagnostic sound, evidently the scar from the chancre. The abdomen was negative. Nervous system:

\* Published with permission of the Surgeon General, who is not responsible for any opinions set forth herein.



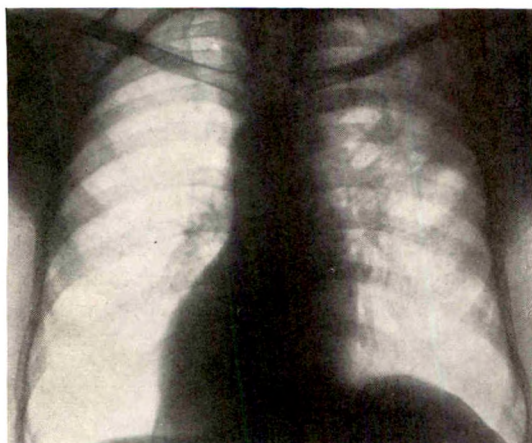


FIG. 3. June 18, 1928. The area of consolidation in the right upper lobe has diminished, leaving only fibrosis.

No Romberg; knee jerks active. Physical examination of the muscular system, bones and joints was negative.

The urine examinations, except for traces of albumin and a few hyaline casts, were negative.

The sputum was negative for tubercle bacilli twelve times from Jan. 21, 1928, to Feb. 27, 1928. It was negative twice in May, 1928.

Complete blood count, Feb. 13, 1928, showed slight secondary anemia, no malarial parasites. Blood Wassermann reactions were 2+ five times in January, 1928, also 2+ on Feb. 27, 1928. It was 1+ May 14, 1928. Spinal fluid, Jan. 16, 1929—cell count per c. mm. 16; globulin negative; Wassermann reaction, negative in all dilutions. Kidney function test and

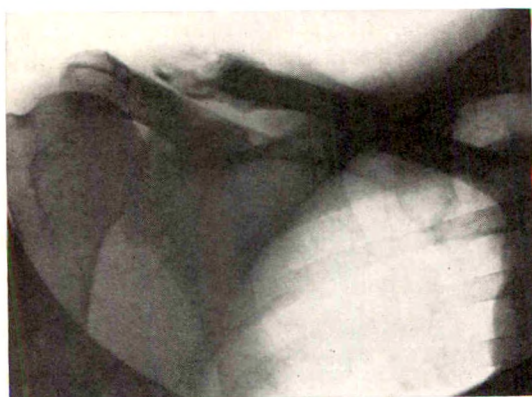


FIG. 4. Jan. 27, 1928. Note the destructive process end of left clavicle.

blood chemistry examination were normal.

*Roentgen Findings.* Jan. 20, 1928—"The right upper lobe, excepting the apex, is the seat of consolidation, fairly homogeneous with multiple areas of circumscribed rarefaction opposite the first interspace, quite likely the result of cavitation. Impression: Chronic pulmonary tuberculosis, moderately advanced, with cavitation. Elsewhere the lungs are clear. The existence of a gumma or an echinococcus cyst should be borne in mind before fully establishing a diagnosis, as it is difficult to believe from the roentgen appearance that this lesion is of long duration. Furthermore, the extremity of the left clavicle appears to be entirely destroyed, giving a blown appearance, which is sometimes seen in tuberculosis of the digit. The right clavicle at its outer extremity, gives a moth-eaten appearance.

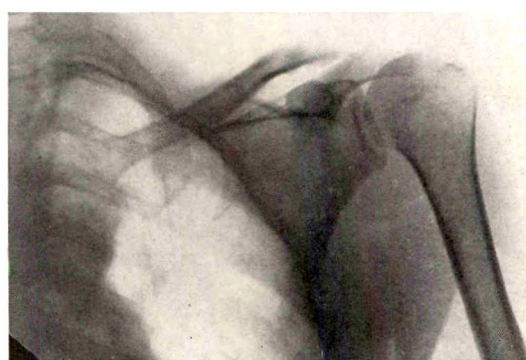


FIG. 5. June 18, 1928. Left clavicle showing bone regeneration.

Further examination of the bones is indicated." Film taken Jan. 24, 1928—"The acromial ends of both clavicles show marked destruction; that is, starting from the medullary side, involving the cortex and periosteum. Elsewhere the bones appear normal." Jan. 30, 1928—"The upper lobe presents the same condition as previously reported. A gumma is to be suspected here. There is destruction of the acromial ends of both clavicles, with but little pain." Feb. 17, 1928—"Consolidation of the right upper lobe shows no further advance. It remains practically the same as previously described. Impression: Gumma of the right upper lobe." Feb. 23, 1928—"The mass is still present in the right upper lobe. I still believe it to be gumma." March 5, 1928—"The area of consolidation interpreted



as being a gumma in the right upper lobe is assuming a more fibrotic appearance and is evidently shrinking. Elsewhere the lungs are clear." March 21, 1928—"The gumma previously reported in the right upper lobe has considerably diminished in size. Furthermore, the destruction at both clavicular outer ends appears to be filling in." May 7, 1928—"There is marked pleural thickening in the right upper lobe. Opposite the 3d interspace is a circular rarefied area, diameter 4 cm., which is either a cavity or a pleuro-annular ring. There is beginning fibrosis radiating out from the hilus into the right middle and lower lobes. The condition is not characteristic of pulmonary tuberculosis. I still believe this is lung syphilis." June 1, 1928—"The pathologic lesion in the right upper lobe has diminished at least three-fourths from the first

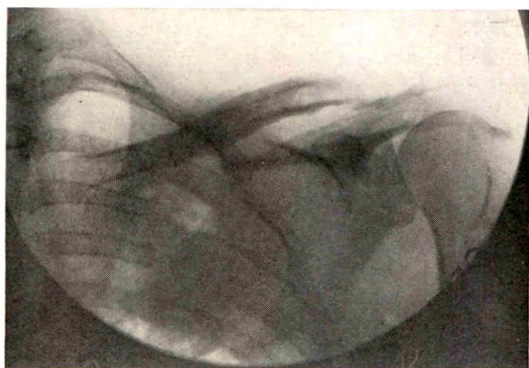


FIG. 6. Jan. 27, 1928. Acromial end right clavicle with bone destruction. Also shows great increase in density in the right upper lobe.

report of last January, the destruction of the distal end of the left clavicle has filled in considerably. This is evidently a luetic process in the lung and clavicular ends." June 18, 1928—"The gumma in the right upper lobe is considerably resolved, leaving areas of fibrosis. The destroyed clavicular ends are filling in with new bone."

*Treatment.* Antiluetic treatment was started Jan. 26, 1928. Sulpharsphenamine, intramuscularly, in 0.4 gram doses every five days until nine doses were taken. Potassium iodide in increasing doses until fifty drops were taken three times a day. Mercury inunctions, one-sixth of an ounce, rubbed daily for thirty min-

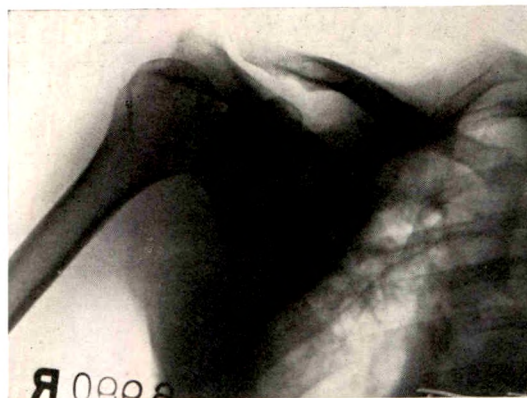


FIG. 7. June 18, 1928. Shows acromial end right clavicle more clear cut, with increased aeration and diminished density in the right upper lobe.

utes, skipping each seventh day, thirty-six treatments. Discharged from the hospital March 20, 1928, for a rest; treatment resumed May 14, 1928, when he had at weekly intervals, up to July 7, 1928, arsenobenzol intravenously, 0.4 gram doses; bismuth salicylate, intramuscularly, in 1 c.c. doses.

*Progress.* The temperature was normal throughout. Weight increased from 108 pounds, Jan. 24, 1928, to 140½ pounds, March 13, 1928—a gain of 32 pounds over this period. On July 3, 1928, his weight was 137½ pounds. Discharged for a month's rest from treatment in April, 1928. Patient went absent without leave July 7, 1928.

#### COMMENT

This is a case of syphilitic lesion in the right upper lobe, probably a gumma. The sputum was repeatedly negative for tubercle bacilli. This patient gained 32 pounds under antiluetic treatment. The lesion in the lung practically disappeared after five months of specific treatment. Furthermore, the chronic osteomyelitis in both clavicular ends showed beginning regeneration of bone. The patient ran no fever during his stay in the hospital. With these facts in mind, there is no doubt that this is a case of tertiary syphilis, accompanied by extensive lesions in the right upper lobe and acromial ends of both clavicles.



## A CASE OF RIGHT-SIDED RELAXATION OF THE DIAPHRAGM\*

By DR. HANS FRITSCH

BIELITZ, POLEN

THE following case of elevation of the diaphragm is reported not only because of its rare occurrence on the right side, but also because the condition was observed over a number of years, thus permitting certain conclusions to be drawn.

### CASE REPORT

The patient, male, aged sixty-seven, retired waiter, first came under our observation in September, 1920, complaining of shortness of breath, especially when walking rapidly or climbing stairs; pressure over the precordium, and dropped heart beats. He was small and delicate, with fragile bones, poor musculature and a thin panniculus; profuse growth of hair over face and scalp, sparsity of pubic hair; genitals small. Married thirty-two years; there were no children; no miscarriages. Denies venereal infection. No sugar or albumin in urine. Small thorax. No enlargement of heart detected by percussion or auscultation. Heart sounds distant, with accentuation of aortic second sound. The limitation of respiratory movement pointed to an elevated diaphragm on the right side. The blood pressure was moderately elevated.

The roentgen examination disclosed a somewhat accelerated, strong, heart action. There was no remarkable enlargement or change in shape. The shadow of the aorta was denser than normal and showed elongation with a pronounced arch. On the right side there was an elevation of the diaphragm which showed a difference of 5 to 6 cm. in height as compared with the left. The extent of respiratory movement on the right was slight as compared with the left side. No paradoxical breathing was observed. There was a dense adhesion at the inner edge of the diaphragm on the right. On both sides there were numerous hilus shadows showing partial calcification. The diagnosis at this time was: Increase in density of aortic shadow without appreciable widening; old indurated process at the hilus with calcification; elevation of the right diaphragm with adhesions

at the inner edge of the diaphragm on the right.

In the following years I had numerous opportunities to examine the patient and found no appreciable change in his condition.

In January, 1925, while carrying a weight of 5-7 kg., the patient had an attack of dyspnea and severe precordial pain, so severe that he had to lie down immediately. The next day the symptoms had disappeared, the patient showing rapid improvement with rest in bed. Respirations normal; pulse, 72, strong, unequal and sometimes arrhythmic. The aortic second sound was accentuated and sharp; the other heart sounds were muffled and distant. Subjectively, the patient felt very well. He admitted that at other times previously, when carrying heavy loads, he had noticed a tired feeling in both arms.

Roentgenoscopic examination and films (Fig. 1) taken a few days after this attack showed a marked elevation of the diaphragm on the right on inspiration, with a difference of 10 cm.

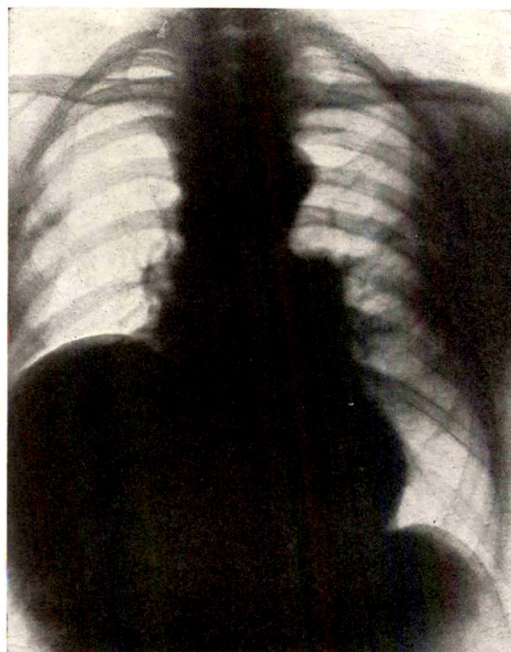


FIG. 1.

\* Read at the Fifth German Roentgen Congress at Prague. Translated from the German by Dr. Frederic Schreiber, Detroit, Mich.

between the level on the left and right sides. With ordinary breathing while standing, there was distinct paradoxical movement. In lying down the elevation of the diaphragm was more marked, but the paradoxical movement was absent and in this position there was a suggestion of normal breathing movements.

With the production of negative pulmonary pressure by an inspiratory act with the glottis closed, the right leaf of the diaphragm moved upward, the left downward (Wellmann phenomenon). On the right side also, there appeared two curved lines crossing at the outer and inner sides of the diaphragm. At the inner edge of the right diaphragm, could be seen the dense shadow of an adhesion, which was also visible in the lateral view as a cord-like structure. The left diaphragm moved well with respiration. At the top of this leaf there was a fairly well-circumscribed pouch measuring about 4 cm. at the base and about 1 cm. in height. Here, too, was seen a double arched line, crossing at the outer and inner sides. There were dense hilus shadows on both sides, especially the left. The lungs showed no appreciable changes. The heart had a slow, powerful rhythm. The size and shape of the heart shadow was within normal limits, though the left auricle and pulmonic arch appeared somewhat accentuated. The shadow of the aorta was more dense than normal. The aortic arch turned acutely to the left and was sharply curved. The shadow of the innominate was prominent. Diagnosis: Relaxation of the right diaphragm; atheromatous aorta without appreciable widening of the arch.

Following this attack, the patient experienced no difficulty when he followed instructions and obtained his necessary rest. In 1926 I moved from Teschen to Bielitz and lost sight of the patient. I was told that he died in 1927, probably of pneumonia following exposure to cold. No autopsy was held.

#### COMMENT

In considering the cause of the one-sided elevation of the diaphragm in this case, the diminished tonus of the diaphragm was due either to injury to the phrenic nerve, or as a result of fatty degeneration of the musculature of the diaphragm. There were no signs of shrinkage

of the lungs or pleura to any extent such as one finds developing after tuberculosis or pneumonia. Neither were there any signs of plugging of a bronchus as in tumors of the lung, increased intraabdominal pressure as found resulting from liver enlargement, nor subphrenic abscess, etc.

If the relaxation of the diaphragm is general, when it is pushed upward by the adjacent intestines, one speaks of a relaxation of the diaphragm. If, however, the intestines enter the thorax through a defect in the diaphragm, regardless whether enclosed in a sac or not, the condition is designated as a diaphragmatic hernia (true or false). Even though the distinction is anatomically clear, yet it may be extremely difficult to distinguish between these conditions in vivo.

Various methods for differential diagnosis of these two pathological conditions of the diaphragm have been suggested. It was thought, for instance, that pneumoperitoneum offered a sure method of differentiation, since the gas enters the thorax through the defect in the diaphragm when a hernia is present and not with relaxation. However, this method may fail because of adhesions at the hernial opening. Another differential method, though useful only in left-sided changes of this sort, consists in measuring the gaseous pressure in the stomach (Hildebrand and Hess). Lowering of this pressure on inspiration and elevation on expiration is peculiar to hernia, while with relaxation of the diaphragm, there is first a decrease, then an increase of pressure on inspiration as well as on expiration. It is also possible to distinguish between these two conditions by comparing the relation of the various organs when the breath is held or when the position of the patient is changed (Beltz).

In using the stomach tube to pump air into or out of the stomach the boundary between stomach and thorax is frequently emphasized in hernia, while in relaxation a regular arch is retained regardless whether the stomach is full of air or empty.

Finally Glässner pointed out a characteristic crossed arch which is supposed to be due to the step-like structure of the diaphragm.

In the case under consideration, pneumoperitoneum could not be done because the patient objected to this procedure. The method of Hildebrand and Hess, and also that of Beltz, was out of the question because of the right-sided lesion. However the crossed arch of Glässner was present, the arch line crossing at the inner and outer side of the dome of the diaphragm.

It was originally assumed, inasmuch as most cases of relaxation of the diaphragm occurred on the left, that the double crossed arch line at the outer and inner side was formed by the diaphragm on the one hand, and the stomach wall, on the other. However, Assmann has already pointed out in his *Handbuch* that there is no ground for this assumption since there is no empty space between the stomach and diaphragm. The present case in which the stomach wall cannot be taken into consideration because of the right-sided lesion, further bears out the contention of Assmann.

As to the etiology and cause of the condition in the present case, we know that in 1920 there was an elevation of the diaphragm but no paradoxical movement was present. The diaphragm at this time was markedly bulging but had not as yet been crippled. The exact time when this loss of function of the right leaf of the diaphragm occurred is naturally impossible to determine. It is also difficult to decide whether the primary cause was a slowly progressive injury to the phrenic nerve due to the tough adhesion at the inner angle of the diaphragm, or whether it was due

to a fatty degeneration of the weakened musculature. However, when we consider the partial bulging of the left leaf of the diaphragm in which two crossing arched lines could also be discerned, in spite of the fact that the respiratory excursions were not markedly interfered with, we may assume that in this case the primary cause of the lesion was a muscular degeneration, inasmuch as no changes occurred on the left side which could be attributed to a lesion of the phrenic nerve.

It is also possible that in this case the musculature of the diaphragm was weak to begin with, since the rest of the muscles in this small man were weak and poorly developed. Added to this is the fact that for years the patient, who was the owner of a small restaurant, did most of the work himself. Now we know that with the structures under discussion, even in robust individuals, certain pathological changes may take place, just as varices and pedes plani occur elsewhere, depending finally upon any unusual demand made on the involved structure.

It is possible that here the many burdens, which may often have been too great for the strength of this poorly developed man, may have played an etiological rôle in the production of this lesion. Any definite proof is of course impossible in this case. The subjective symptoms appear to be those resulting from compression of the thoracic viscera as a result of abdominal pressure upon a relaxed leaf of the diaphragm.

#### SUMMARY

A case is reported of right-sided relaxation of the diaphragm, with partial left-sided debility.



# THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

*Editor:* LAWRENCE REYNOLDS, M.D.

*Editorial Board:* A. C. CHRISTIE, M.D. H. K. PANCOAST, M.D. WILLIAM DUANE, PH.D.

*Advisory Board for Pathology:* JAMES EWING, M.D. EUGENE OPIE, M.D. A. S. WARTHIN, M.D.

*Collaborating Editors:* The Officers and Committee Members of the Societies of which this JOURNAL is the official organ, whose names appear on this page, are considered collaborating editors of this JOURNAL.

*Foreign Collaborators:* A. BÉCLÈRE, M.D., PARIS, GÖSTA FORSSELL, M.D., STOCKHOLM, G. F. HAENISCH, M.D., HAMBURG, R. LEDOUX-LEBARD, M.D., PARIS.

*Publisher:* CHARLES C. THOMAS, SPRINGFIELD, ILL.

*Issued Monthly. Subscription \$10.00 per year, \$11.00 in Canada and \$12.00 in foreign countries. Advertising rates submitted on application. Editorial office, 110 Professional Building, Detroit, Mich. Office of publication, 220 E. Monroe St., Springfield, Ill. Information of interest to all readers will be found on page iv.*

## Officers and Standing Committees

### THE AMERICAN ROENTGEN RAY SOCIETY

*President:* H. M. IMBODEN, New York City;  
*President-Elect:* A. B. MOORE, Washington, D. C.;  
*1st Vice-President:* H. E. RUGGLES, San Francisco, Calif.; *2nd Vice-President:* B. H. NICHOLS, Cleveland, Ohio; *Secretary:* JOHN T. MURPHY, 421 Michigan St., Toledo, Ohio; *Treasurer:* WILLIAM A. EVANS, 10 Peterboro St., Detroit, Mich.; *Librarian and Historian:* H. W. DACHTLER, Toledo, Ohio.

*Executive Council:* W. F. MANGES, Chairman, 235 S. 15th St., Philadelphia, Pa., L. R. SANTE, St. Louis, Mo., F. M. HODGES, Richmond, Va., H. M. IMBODEN, New York City, A. B. MOORE, Rochester, Minn., LAWRENCE REYNOLDS, Detroit, Mich., JOHN T. MURPHY, Toledo, Ohio, WILLIAM A. EVANS, Detroit, Mich.

*Committee on Laws and Public Policy:* B. R. KIRKLIN, Chairman, Rochester, Minn., FRED M. HODGES, Richmond, Va., WILLIAM E. CHAMBERLAIN, San Francisco, Calif.

*Committee on Safety and Standards:* P. M. HICKEY, Chairman, University Hospital, Ann Arbor, Mich., H. K. PANCOAST, Philadelphia, Pa., W. D. COOLIDGE, Schenectady, N. Y., A. U. DESJARDINS, Rochester, Minn., H. J. ULLMANN, Santa Barbara, Calif., B. H. NICHOLS, Cleveland, Ohio, G. E. RICHARDS, Toronto, Canada, R. R. NEWELL, San Francisco, Calif.

*Publication Committee:* WILLIAM A. EVANS, Chairman, Detroit, Mich., W. F. MANGES, Philadelphia, Pa., L. R. SANTE, St. Louis, Mo.

*Leonard Prize Committee:* P. M. HICKEY, Chairman, Ann Arbor, Mich., W. B. BOLMAN, Los Angeles, Calif., A. C. CHRISTIE, Washington, D. C., W. A. EVANS, Detroit, Mich., G. W. GRIER, Pittsburgh, Pa., B. H. NICHOLS, Cleveland, Ohio, G. E. PFAHLER, Philadelphia, Pa.

*Tube Committee:* DAVID R. BOWEN, Chairman, Philadelphia, Pa., I. H. LOCKWOOD, Kansas City, Mo., E. C. ERNST, St. Louis, Mo., G. W. GRIER, Pittsburgh, Pa., E. A. POHLE, Madison, Wis.

*Member, National Research Council:* W. F. MANGES, Philadelphia, Pa.

*Delegate to Third International Congress, Paris,*

*July 27-31, 1931:* P. M. HICKEY, Ann Arbor, Mich.; Alternate, LEOPOLD JACHES, New York City.

*Editor:* LAWRENCE REYNOLDS, 110 Professional Building, Detroit, Mich.

*Editorial Board:* A. C. CHRISTIE, H. K. PANCOAST, WM. DUANE.

*Advisory Board for Pathology:* James Ewing, EUGENE OPIE, ALDRED S. WARTHIN.

*Publisher:* CHARLES C. THOMAS, 220 East Monroe St., Springfield, Ill.

*Thirty-second Annual Meeting:* Atlantic City, N. J., 1931.

### THE AMERICAN RADIUM SOCIETY

*President:* H. J. ULLMANN, 1520 Chapala St., Santa Barbara, Calif.; *President-Elect:* SANFORD WITHERS, Denver, Colo.; *First Vice-President:* BURTON J. LEE, New York City; *Second Vice-President:* EDWARD H. SKINNER, Kansas City, Mo.; *Secretary:* G. W. GRIER, Jenkins Arcade, Pittsburgh, Pa.; *Treasurer:* ZOE A. JOHNSTON, Jenkins Arcade, Pittsburgh, Pa.

*Executive Committee:* CURTIS F. BURNAM, Chairman, 1418 Eutaw Place, Baltimore, Md., EDWIN C. ERNST, St. Louis, Mo., H. H. BOWING, Rochester, Minn.

*Program Committee:* SANFORD WITHERS, Chairman, 304 Republic Bldg., Denver, Colo., BURTON J. LEE, New York City, HENRY SCHMITZ, Chicago.

*Publication Committee:* EDWARD H. SKINNER, Chairman, 1532 Professional Bldg., Kansas City, Mo., HENRY SCHMITZ, Chicago, DOUGLAS QUICK, New York City.

*Research and Standardization Committee:* G. FAILLA, Chairman, Memorial Hospital, New York City, H. J. ULLMANN, Santa Barbara, Calif., R. B. GREENOUGH, Boston, Mass.

*Education and Publicity Committee:* SANFORD WITHERS, Chairman, 304 Republic Bldg., Denver, Colo., G. E. PFAHLER, Philadelphia, T. D. QUIGLEY, Omaha, Nebr.

*Sixteenth Annual Meeting:* Philadelphia, 1931.

*Committee on Arrangements:* G. E. PFAHLER, Chairman, 1321 Spruce St., Philadelphia, W. S. NEWCOMET, Philadelphia, H. K. PANCOAST, Philadelphia, W. H. SCHMIDT, Philadelphia, W. L. CLARK, Philadelphia.

# EDITORIALS

## THE ANNUAL MEETING

THE Thirty-first Annual Meeting of the American Roentgen Ray Society was held at West Baden Springs Hotel, West Baden, Indiana, Sept. 23 to 25, 1930. The committee of arrangements in choosing West Baden made a departure from the usual custom by selecting a place which had no hospitals affording clinical facilities. It was thought by the committee that the meeting in such a splendid resort hotel would afford the members an opportunity to escape from the city and at the same time there would be no outside activities to interfere with the attendance at the meetings, and in this they were not mistaken for perhaps never have the various scientific sessions been better attended.

The program arranged by the President-elect, Dr. A. B. Moore, was an excellent one. The range of the subjects discussed was wide and the contributions from the members and invited guests set a high standard. A mere recital of some of the titles of the papers read gives an indication of the extent to which the roentgen ray has been utilized as a diagnostic and therapeutic agent in medicine since its discovery: "Opaque Oil in Maxillary Sinus Disease;" "Pneumoconiosis;" "Blood Changes in the Lymphomata and the Leukemias and their Bearing on Roentgen-Ray Therapy;" "The Value of Roentgen Examination in Pulmonary Tuberculosis;" "Tuberculous Atelectatic Cirrhosis of the Lungs; Its Roentgenologic Significance;" "Intravenous Urography." There were of course numerous others of high merit and of incalculable importance. All of the papers will in due course of time be published in the Journal.

Aside from the scientific program, arrangements were made for the entertainment of those in attendance. On Monday

afternoon, the day before the opening of the meeting, the annual golf tournament was held over the West Baden Springs Hotel course. Twenty-four golfers played eighteen holes which resulted in ties not only in the low gross but in the low net scores. These ties were played off on Tuesday with the result that the championship cup was presented to Dr. W. F. Manges, while the handicap championship trophy went to Dr. W. W. Belden.

On Tuesday evening Dr. Otto Glasser gave an entertaining talk on the life of William Konrad Roentgen and his discovery of the x-rays, illustrating his talk with many photographs of Roentgen, his family, his friends, and added a humorous touch by showing current comments and cartoons which appeared in the daily press at the time of the discovery. On this same evening, Dr. E. H. Skinner gave a talk on "American Roentgenology, Early Journals and Books" which added a delightful chapter to our rapidly accumulating historical data, and it is of tremendous importance to the Society and to roentgenologists in general that this material is being gathered together at this time when there are still living many men who participated in the early work with the roentgen ray. Dr. Skinner called particular attention to the fact that many of the early publications in this country dealing with the roentgen ray are difficult to obtain and those who have an interest in collecting books relative to their specialty would do well to avail themselves of every opportunity to acquire these rare books.

The Society was fortunate this year in having as the Caldwell Lecturer Dr. W. D. Coolidge, who chose as his subject "The Development of Modern X-Ray Generating Apparatus." In this he discussed the

historical development of the hot cathode tube, illustrating his talk with designs of the various tubes which he employed in his experimental and practical work and with illustrations of those now in common use. Roentgenology owes a great debt of gratitude to Dr. Coolidge for his contributions not only in this field of scientific work but for his many helpful suggestions and criticisms.

Those in charge of arrangements for the meeting wish, through the Journal, to express their thanks to all who contributed to the success of the meeting, and their especial thanks are extended to the manager and the staff of the West Baden Springs Hotel for their many courtesies and kindnesses shown to members and their guests.

## APPOINTMENT OF DR. MORISON AS PROFESSOR OF RADIOLOGY, UNIVERSITY OF LONDON

THE many friends and acquaintances of Dr. J. M. Woodburn Morison will be interested in the following announcement appearing in the *British Journal of Radiology*, September, 1930, p. 390:

"Dr. J. M. Woodburn Morison, lecturer in radiology in the University of Edinburgh and radiologist to the Royal Infirmary of Edinburgh, has been appointed professor of radiology in the University of London, and Director of the radiological department of the Cancer Hospital, Fulham, in succession to the late Dr. Robert Knox. This is the first Chair of Radiology to be established in this country. The duties include the practice of X-ray and radium therapy at the Cancer Hospital, and the instruction of students in these subjects.

Dr. Woodburn Morison, who is a native of Ayrshire, graduated at Glasgow University in 1896, and became assistant radiologist to the Royal Infirmary of Manchester, and consulting radiologist to the Ancoats Hospital, Manchester. He holds the Diploma in Radiology of the University of Cambridge, and has written much upon various aspects of the subject. He has been prominently connected with the Institute since its foundation, and is President of the Electrotherapeutics Section of the Royal Society of Medicine. He is a member of the Radium Commission and the Radium Trust. The Cancer Hospital, which is erecting a new radiological department, is to be congratulated, on its new appointment and bringing Dr. Morison to London."



# SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

*Items for this section solicited promptly after the events to which they refer.*

## MEETINGS OF ROENTGEN SOCIETIES\*

### UNITED STATES OF AMERICA

#### AMERICAN ROENTGEN RAY SOCIETY

Secretary, Dr. John T. Murphy, 421 Michigan St., Toledo, Ohio.

Thirty-second Annual Meeting: Atlantic City, N. J., 1931.

#### AMERICAN COLLEGE OF RADIOLOGY

Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles, Calif.

Annual Meeting: Philadelphia, 1931.

#### SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION

Secretary, Dr. G. W. Grier, Jenkins Arcade, Pittsburgh, Pa.

Annual meeting: Philadelphia, 1931.

#### RADIOLOGICAL SOCIETY OF NORTH AMERICA

Secretary, Dr. I. S. Trostler, 812 Marshall Field Annex, Chicago, Ill.

Sixteenth annual session: Los Angeles, Calif., Dec. 1-5, 1930.

#### RADIOLOGICAL SECTION, LOS ANGELES COUNTY MEDICAL SOCIETY

Secretary, Dr. Orville N. Meland, 1407 S. Hope St., Los Angeles.

Meets on the third Wednesday of each month at the California Hospital.

#### RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION

Secretary, Dr. W. S. Lawrence, Medical Arts Bldg., Memphis, Tenn.

#### BUFFALO RADIOLOGICAL SOCIETY

Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St.

Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.

#### CHICAGO ROENTGEN SOCIETY

Secretary, Dr. George M. Landau, 660 Groveland Park.

Meeting second Thursday of each month October to May inclusive at Virginia Hotel.

#### CLEVELAND RADIOLOGICAL SOCIETY

Secretary, Dr. Harry L. Farmer, 2930 Prospect Ave.

Meetings are held at 6 o'clock at the University Club on the fourth Monday evening of each month from September to April, inclusive.

\* Secretaries of societies not here listed are requested to send the necessary information to the Editor.

#### DETROIT ROENTGEN RAY AND RADIUM SOCIETY

Secretary, Dr. O. J. Shore, Fisher Building.

Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

#### CENTRAL ILLINOIS RADIOLOGICAL SOCIETY

Secretary, Dr. H. C. Kariher, Decatur, Illinois. Regular meetings held quarterly.

#### INDIANA ROENTGEN SOCIETY

Secretary, Dr. J. N. Collins, Indianapolis, Ind. Annual meeting each February 22 in Indianapolis.

#### MILWAUKEE ROENTGEN RAY SOCIETY

Secretary, Dr. J. E. Habbe, 221 Wisconsin Ave., Milwaukee.

Meets first Friday in October, December, February and April.

Place of meeting designated by the president.

#### MINNESOTA RADIOLOGICAL SOCIETY

Secretary, Dr. L. G. Rigler, University Hospital, Minneapolis, Minn.

Next meeting, Minneapolis, Minn., Oct. 25, 1930.

#### NEW ENGLAND ROENTGEN RAY SOCIETY

Secretary, Dr. Thomas R. Healy, 370 Marlboro St., Boston, Mass.

Meets monthly on third Friday, Boston Medical Library.

#### NEW YORK ROENTGEN SOCIETY

Secretary, Dr. J. Bennett Edwards, Englewood Hospital, Englewood, N. J.

Meets monthly on third Monday, New York Academy of Medicine, at 8:30 P.M.

#### CENTRAL NEW YORK ROENTGEN RAY SOCIETY

Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

#### PACIFIC COAST ROENTGEN RAY SOCIETY

Secretary, Dr. Harold B. Thompson, Seattle, Wash. Two meetings a year.

#### PENNSYLVANIA RADIOLOGICAL SOCIETY

Secretary, Dr. W. E. Reiley, Clearfield, Penna. Two meetings a year, April and October.

#### PHILADELPHIA ROENTGEN RAY SOCIETY

Secretary, Dr. Karl Kornblum, 3400 Spruce St. Meeting first Thursday of each month from October to May inclusive, at 8:15 P.M., in Thomson Hall, College of Physicians, 19 S. 22d St.



**ROCHESTER ROENTGEN RAY SOCIETY,  
ROCHESTER, N. Y.**

Secretary, Dr. Camp C. Thomas, 476 Lake Ave.  
Meets monthly on the first Friday evening at 7:45  
at the Rochester Medical Association Building.

**ST. LOUIS ROENTGEN CLUB**

Secretary-Treasurer, Dr. L. R. Sante, Missouri  
Building.

Meets first week of each month. Time and place of  
meetings designated by president.

**TEXAS RADIOLOGICAL SOCIETY**

Secretary-Treasurer, Dr. C. P. Harris, Houston,  
Texas.

Meets annually one day preceding the meeting of the  
Texas State Medical Association.

**UNIVERSITY OF MICHIGAN ROENTGEN  
RAY SOCIETY**

Secretary, Dr. D. M. Clark, University Hospital,  
Ann Arbor, Mich.

Meets every Wednesday evening from September to  
July, at 7:30 o'clock in the amphitheatre of the  
University Hospital.

**VIRGINIA ROENTGEN RAY CLUB**

Secretary, Dr. Wright Clarkson, 205 S. Sycamore  
St., Petersburg, Va.

Next meeting, Norfolk, Va., 1 P.M., Wednesday,  
Oct. 22, 1930.

**CUBA****SOCIEDAD CUBANA DE RADIOLOGIA Y  
FISIOTERAPIA**

Secretary, Dr. Francisco Padron, Enrique Vil-  
luendas 64, Havana, Cuba. Meets monthly in  
Havana.

**BRITISH EMPIRE****BRITISH INSTITUTE OF RADIOLOGY IN-  
CORPORATED WITH THE RÖNTGEN SO-  
CIETY**

Meets on the third Thursday of each month, from  
November to June inclusive, at 8:15 P.M., at 32  
Welbeck St., London, W. 1., or as advertised.

**ELECTRO-THERAPEUTIC SECTION OF THE  
ROYAL SOCIETY OF MEDICINE (CON-  
FINED TO MEDICAL MEMBERS)**

Meets on the third Friday of each month during the  
winter at 8:30 P.M. at the Royal Society of Medi-  
cine, 1 Wimpole St., London, W. 1.

**SECTION OF RADIOLOGY AND MEDICAL  
ELECTRICITY, AUSTRALASIAN MEDICAL  
CONGRESS**

Secretary, Dr. H. M. Cutler, 139 Macquarie St.,  
Sydney, New South Wales.

**RADIOLOGICAL SECTION OF THE VIC-  
TORIAN BRANCH OF THE BRITISH MED-  
ICAL ASSOCIATION**

Secretary, Dr. Colin Macdonald, Lister House, 61  
Collins St., Melbourne, Australia.

Meets monthly at Melbourne during the winter.

**SECTION ON RADIOLOGY, CANADIAN MED-  
ICAL ASSOCIATION**

Secretary, Dr. A. H. Rolph, 160 St. George St.,  
Toronto, Ont.

**RADIOLOGICAL SECTION, NEW ZEALAND  
BRITISH MEDICAL ASSOCIATION**

Secretary, Dr. P. C. Fenwick, The Hospital,  
Christ-church.

Meets annually.

**CONTINENTAL EUROPE****BELGIAN SOCIETY OF ROENTGENOLOGY**  
Secretary, Dr. J. Boine, Avenue des Alliés, 134,  
Louvain (Belgium).

Meets monthly on second Sunday at d'Egmonds  
Palace, Brussels, except in the summertime.

**SOCIÉTÉ DE RADIOLOGIE MÉDICALE DE  
FRANCE**

Meets monthly on second Tuesday, except during  
months of August and September, 12 Rue de  
Seine, Paris.

**SOCIÉTÉ SUISSE DE RADIOLOGIE (SCHWEL-  
ZERISCHE RÖNTGEN-GESELLSCHAFT)**

Secretary for French language, Dr. A. Grosjean,  
La Chaux de Fonds.

Secretary for German language, Dr. Scheurer,  
Molzgasse, Biel.

Meets annually in different cities.

**SOCIÉTÉ FRANCAISE D'ELECTROTHÉRA-  
PIE ET DE RADIOLOGIE MÉDICALE**

Meets monthly on fourth Tuesday, except during  
months of August and September, 12 Rue de  
Seine, Paris.

**ASSOCIATION OF GERMAN ROENTGEN-  
OLOGISTS AND RADIOLOGISTS IN CZECH-  
O-SLOVAKIA**

Secretary, Dr. Walter Altschul, German Univer-  
sity, Prague, 11/52.

**DEUTSCHE RÖNTGEN-GESELLSCHAFT (GE-  
SELLSCHAFT FÜR RÖNTGENKUNDE UND  
STRAHLENFORSCHUNG)**

Meets annually in April, alternating one year in  
Berlin, one year in some other German city. Meets  
in addition every two years with the Gesellschaft  
deutscher Naturforscher und Aerzte.

Permanent secretary, Professor Dr. Haenisch,  
Klopstockstrasse 10, Hamburg, Germany.

**SÜD- UND WESTDEUTSCHE RÖNTGENGE-  
SELLSCHAFT**

Meets annually in different cities.

**NORD- UND OSTDEUTSCHE RÖNTGENGE-  
SELLSCHAFT**

Meets annually in different cities.

**DUTCH SOCIETY OF ELECTROLOGY AND  
ROENTGENOLOGY**

Holds two meetings a year in Amsterdam, one in the  
Spring, and one in the Fall.

**SOCIETA ITALIANA RADIOLOGIA MEDICA**  
Secretary, Professor M. Ponzio, University of  
Turin, Turin.

**SOCIETATEA ROMANA DE RADIOLOGIE SI  
ELECTROLOGIE**

Secretary, Dr. Nicolae Busila, 44 Elizabeta Blvd.,  
Bucarest.

Meets second Monday in every month with the ex-  
ception of July and August.

**ALL-RUSSIAN ROENTGEN RAY ASSOCIA-  
TION, LENINGRAD, USSR** in the State Insti-  
tute of Roentgenology and Radiology, 6 Roentgen  
St.

Secretaries, Drs. S. A. Reinberg and S. G. Simon-  
son.

Meets annually.

**LENINGRAD ROENTGEN RAY SOCIETY**

Secretaries, Drs. S. G. Simonson and G. A.  
Gusterin.

Meets monthly on the first Monday at 8 o'clock in  
the State Institute of Roentgenology and Radi-  
ology, Leningrad.

**MOSCOW ROENTGEN RAY SOCIETY**

Secretaries, Drs. L. L. Holst, A. W. Ssamycin and  
S. T. Konobejevsky.

Meets monthly on the first Monday at 8 o'clock, the  
place of meeting being selected by the Society.

**POLISH SOCIETY OF RADIOLOGY**

Secretary, Dr. A. Elektorowicz, 19 Hoza St., War-  
saw. Meets annually.

**WARSAW SECTION, POLISH SOCIETY OF  
RADIOLOGY**

Secretary, Dr. B. Krynski, 11 Zielna St.

Meets once a month except in the summertime.

**SCANDINAVIAN ROENTGEN SOCIETIES**

The Scandinavian roentgen societies have formed a  
joint association called the Northern Association  
for Medical Radiology, meeting every second year  
in the different countries belonging to the Associa-  
tion. Each of the following societies, with the ex-  
ception of the Denmark Society, meets every  
second month except in the summertime:

**SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN**  
Meets in Stockholm.

**SOCIETY OF MEDICAL RADIOLOGY IN NORWAY**  
Meets in Oslo.

**SOCIETY OF MEDICAL RADIOLOGY IN DENMARK**  
Secretary, Dr. O. Wissing, Copenhagen.

Meets on the second Wednesday of each month from  
October to July in Copenhagen, at 8 o'clock in the  
State Institute of Roentgenology.

**SOCIETY OF MEDICAL RADIOLOGY IN FINLAND**  
Meets in Helsingfors.

**VIENNA SOCIETY OF ROENTGENOLOGY**

Secretary, Professor Holzknecht, Vienna, IX, Gen-  
eral Hospital.

Meets on the first Tuesday of each month from  
October to July.

## THE SCIENTIFIC EXHIBIT

The Scientific Exhibit at the West Baden  
meeting was as comprehensive and in-  
structive as was the scientific program and  
those who spent the amount of time and  
energy necessary in the preparation of such  
valuable exhibits deserve the heartiest com-  
mendation.

Drs. T. O. Menees, J. D. Miller and  
L. E. Holly, Blodgett Memorial Hospital,  
Grand Rapids, Michigan had an exhibition  
on "Amniography." This is a somewhat new  
departure in roentgenography. The films  
were excellent, illustrating splendidly the  
points in question. While this is a new  
technique, in the hands of those who will  
apply it with caution, it will undoubtedly  
help to obviate some of the accidents in  
obstetrics, and will no doubt lead to further  
useful developments. A description of this  
method, with illustrations, will be found in  
this number of the Journal. This exhibit  
was selected by the committee on awards,  
composed of Dr. A. L. Gray, Dr. E. H.  
Skinner and Dr. W. B. Bowman, as being  
the "most original."

The Indiana University Hospitals, In-  
dianapolis, sent an exhibit on "Bone Le-  
sions Involving Bone Nuclei, Epiphyseal  
and Juxta-epiphyseal." This subject was  
illustrated with a comprehensive group of  
cases showing these various lesions in all  
parts of the body, and it is just such ex-  
hibits which focus attention on many  
closely allied conditions involving the  
bones whose roentgen and clinical differ-  
entiation is somewhat difficult.

The exhibit prepared by Drs. R. C.  
Beeler, L. A. Smith and J. N. Collins,  
Indianapolis, was on "Opaque Oils in Study  
of Antra." This consisted of films of the  
antra taken in the various positions, in-  
cluding a lateral study both before and  
after the injection of opaque oils. The im-  
portance was illustrated of studying certain  
selected cases of antral disease with opaque  
oils which bring into relief definitely sus-  
pected lesions not demonstrable on the  
films before the injection. It also brought  
out a valuable point in technique, namely,

the importance of taking the films at such an angle as to avoid the obscuration of the inferior portions of the antra by the overlapping shadows of the teeth. This exhibit was quite inclusive showing many pathological conditions, and also some cases with hypertrophy of the mucosa following the injection of the opaque oils.

Dr. B. R. Kirklin's exhibit from the Mayo Clinic covered three subjects—"Cholecystography;" "Urography;" "Gastrointestinal Lesions." The exhibit on oral cholecystography was most instructive, showing the absolute necessity of almost perfect technique in the demonstration of minute stone shadows and small polypi in the gall-bladder. Dr. Kirklin is to be congratulated on this comprehensive exhibit, which contained a world of information, and those who were privileged to make a detailed study of the films undoubtedly found it of great interest. In addition to the roentgenograms showing the various types of gall-bladders and stone shadows, the technique of administration of the dye was given, and there were photographs illustrating the position of the patient.

The exhibit on urography consisted of films taken after the intravenous administration of uroselectan. There were shown many pathological conditions of the urinary tract, together with the normal; the films were excellent, and the absence of gas in the intestinal tract was worthy of note.

The exhibit on gastrointestinal lesions consisted in films showing lesions of the colon among which were carcinomata and polyposis, multiple strictures of the sigmoid, as well as many showing ulcerative colitis.

The exhibit of Dr. Russell S. Rowland, from the Children's Clinic, assisted by Harper Hospital, Detroit, Michigan, was entitled "Anomalies of Lipoid Metabolism." These and the allied conditions—Gaucher's disease, Schüller-Christian's disease, and Niemann-Pick's disease—were illustrated with many films, photomicrographs, and photographs of the patients having these lesions, together with charts

showing the clinical features in each individual group of cases and photographs of the pathological specimens. The great fund of information contained in Dr. Rowland's exhibit and its extreme importance in the differentiation of many obscure bone lesions were recognized by the committee which designated this as the "most educational."

Dr. R. S. Bromer, Children's Hospital, Philadelphia, had a comprehensive group of films on "Rickets." These showed various stages of the rachitic lesions, together with chest films illustrating the effect of rickets on the thoracic walls, as well as the intrapulmonary lesions often seen in rachitic conditions.

The exhibit of Drs. G. E. Pfahler and Jacob Vastine, Philadelphia, was on "Radium in Treatment of Cancer of the Mouth." This was illustrated with charts, photographs and roentgenograms of the patients showing the method of application together with the amount of radium used, as well as the filter, the distance and the time. In addition, there was a group of plaster models of the face showing the wax molds in position and the padding used for the radium packs. These plaster models illustrated in detail the special plan of treatment outlined for each case.

Dr. Otto Glasser of the Cleveland Clinic Foundation had a most interesting exhibit on "W. C. Roentgen and the Early History of the X-Ray." This contained many photographs of Roentgen, his family, his friends and his birthplace. There were also shown the earliest publications on Roentgen's discovery of the x-ray, together with some of the earliest x-ray tubes. Also of interest were the current comments and cartoons on the discovery. This material is being assembled and is to be published shortly by Dr. Glasser, and every roentgenologist should avail himself of the opportunity to acquire this life of Roentgen as soon as it comes from the press. This exhibit was considered by the committee to have "most profound merit."

Drs. Martin and Martin, Baylor Medical School, Dallas, Texas, had an exhibit on

"Cancer of the Mouth Treated by the English Method." This method was illustrated with crayon drawings showing the application and embedding of the radon needles and also photographs of the patients before and after treatment. In this technique the radon needles are embedded and sewed in and remain in place for a given number of days.

Of unusual interest was the exhibit of Dr. V. W. Archer, University, Virginia, on "Roentgen Diagnosis of Intestinal Ascariasis." Films were shown demonstrating intestinal ascariasis after the administration of barium. Dr. Archer is to be congratulated on the excellence of his films and the value of this study. The committee recognized Dr. Archer's contribution to roentgenology by judging it to have "most excellent merit."

Although to the great regret of those in attendance Dr. Hickey was not able to be present, he showed his continued interest in the Society by sending an exhibit on "Pulmonary Metastatic Neoplasms." The various types of carcinoma metastases to the lungs were shown, with many films pointing out the possibility of confusion with other lesions of the lungs.

"Encephalo-Ventriculograms in Fixed Lesions in Children" was the title of the exhibit of Dr. E. C. Vogt, Children's Hospital, Boston. This was a very beautiful collection of encephalo-ventriculograms demonstrating the various types of fixed lesions of the brain in children, including birth injuries, porencephaly, post-encephalitic changes and the ravages caused by pertussis. In addition he exhibited films of several cases showing the effects of lead poisoning, in which condition the diagnosis can be made by roentgen studies of the epiphyseal areas. An article dealing with this subject is soon to be published in the Journal.

The exhibit of Dr. S. A. Robins, Beth Israel Hospital, Boston, was called "Uterotubography." This was a very complete exhibit of uterotubograms showing a few normal and many pathological conditions

of the uterus and tubes as outlined by lipiodol. Dr. Robins has developed his own technique and instruments, a full description of which has been published in this Journal. Some of the films showed multiple fibroliomyoma, and there were many films illustrating hyperplastic endometritis and some showing the change in size of the uterus during pregnancy and after parturition.

Dr. M. C. Sosman, Peter Bent Brigham Hospital, had an exhibit on "Diseases and Tumors of the Skull and Brain." This was a series of films from the clinic of Dr. Harvey Cushing, including all the various forms of tumors and diseases involving the cranial vault as well as the brain. This demonstration was in the nature of an atlas, all the various diseases being grouped together and different phases or locations of the same lesions being comparable by serial or contrasting films. It is to be hoped that no one failed to avail himself of the opportunity to examine this exhibit as perhaps from no other clinic in the world could such a group of cases be gathered. The Society is much indebted to Dr. Sosman and Dr. Cushing for this exhibit.

Dr. Robert B. Taft, Charleston, S. C., exhibited the instrument which he devised, namely, an "Automatic Polarizer for Synchronous Rectifier." A complete description of this instrument appears in the September number of the Journal. This accomplishment of Dr. Taft's was noted by the committee as being of "extreme scientific importance."

The exhibit of Drs. Pancoast, Pendergrass and Kornblum, Department of Radiology, Hospital of the University of Pennsylvania, was grouped under three headings—"Friedländer's Pneumonia;" "Pneumoconiosis;" "Intravenous Urography." That on Friedländer's pneumonia illustrated roentgenographically four stages of the disease which may be recognized: first, an initial or bronchopneumonic stage, usually of short duration; second, the pseudolobar stage in which the consolidated areas of the lung appear to have a



plaques, applicators or packs. To use it, the plate of wax is placed in water at 50-52°C. and allowed to become pliable. The amount required for making a particular applicator is cut off the plate and molded over the lesion—the sawdust impregnated

ping the tubes therein and allowing the melted wax to cool over.

If additional protection of adjacent structures against the radiant energy is required, lead barriers may readily be attached to the wax. The molds may be removed and cleansed daily with soap and

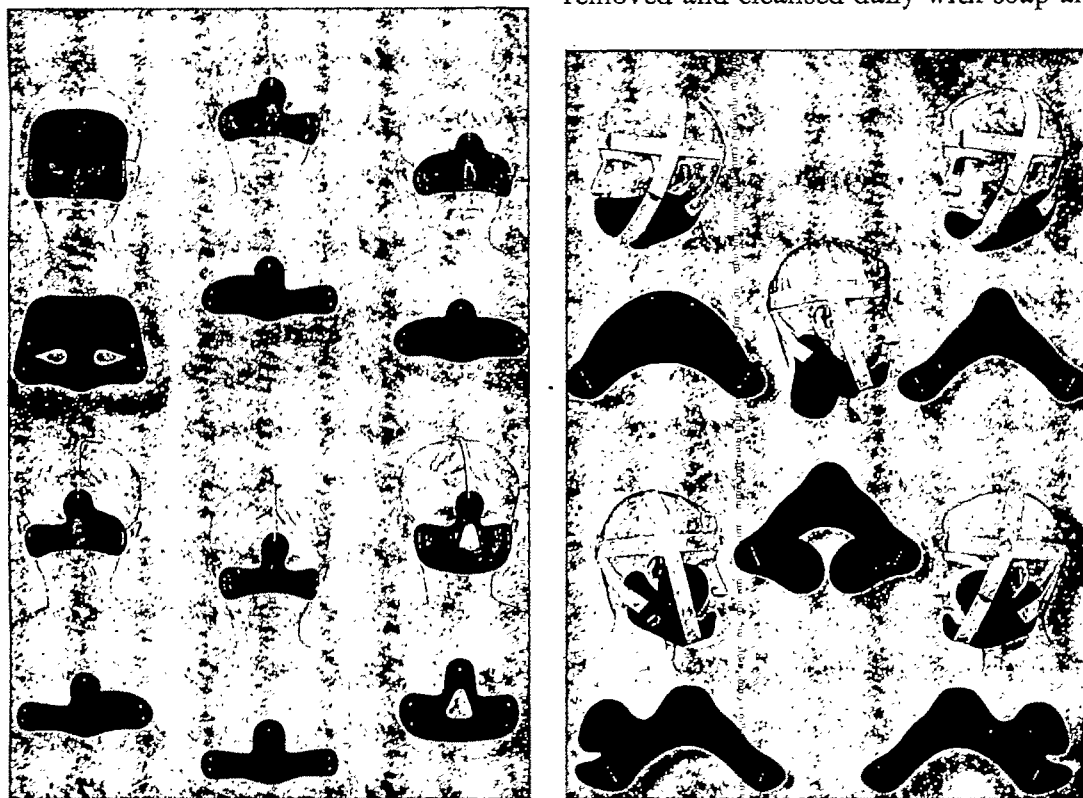


FIG. 1. Showing the various types of masks which can be made with radon wax (Bruneau & Co., Paris)

surface next to the skin. Care is used to mold this wax evenly over the lesion in order not to alter its uniform thickness. After the mold is shaped it is placed in cold water and slightly fixed; then it is applied again before hardening, for final adjustment to the contours of the patient. Necessary holes for eyes, nose or lips can be cut through the wax with a warm knife blade before the mold is entirely hardened. In order to hold it in place it is tied with tapes through holes which are pushed through the borders of the mold by means of a heated awl. The radium or radon tubes in their proper filters are then attached to the mold by warming them slightly and dropping them in place on the wax surface, or by melting grooves in the wax and dropping the surface to the radiant energy source,

water and replaced without losing their form or shape.

To make packs on which large quantities of radium or radon may be used, and where it is necessary to increase the distance from several layers of wax are built up to the required distance by melting one plate to the other.

The illustrations in Figure 1 will serve to show the various forms and shapes and the modes of application of several types of molds made from this wax.

#### CONCLUSION

A convenient means of making radium and radon surface applicators calls for a special material. Radon wax is an easily procured and readily molded substance, and can without difficulty be formed into such devices as the needs of the case require.

## BOOK REVIEWS

*Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.*

THE EFFECT OF ROENTGEN IRRADIATION ON THE INTERRELATION BETWEEN MALIGNANT TUMORS AND THEIR HOSTS. (*Acta radiol., Suppl. VIII.*) By Carl Krebs. Paper. Price, Sw. cr. 8. Pp. 133, with illustrations. Stockholm: P. A. Norstedt & Soner, 1929.

This monograph is an experimental attempt to answer the questions: (1) How large a dose of roentgen rays is needed in order to produce a lethal effect on the cancer cell? (2) Is it possible to demonstrate any effect on cancer cells from doses that do not kill the latter? (3) Is it possible, by local roentgen irradiation, either to increase or to lower the resistance of an organism to a cancer tissue implanted either intracutaneously or subcutaneously in the exposed area.

A spontaneous carcinoma of the mammary gland which arose in the author's stock of mice was used for transplantation. This carcinoma corresponds to the simple adenocarcinoma as described by Apolant. Transplanted by careful aseptic methods this tumor gave an average of 50 per cent takes with 7 per cent metastases in the lungs.

A sarcoma which arose in a tar-painted mouse was also used for transplanting. This tumor showed a tendency to grow through the skin and muscle and frequently ulcerated. When implanted subcutaneously it gave 20 per cent metastases and when implanted intracutaneously metastases occurred as high as 60 per cent. Transplantation takes with this tumor averaged about 95 per cent.

These tumors were transplanted into mice. The author does not state the pedigree of the 835 animals used except that in so far as possible animals of the same weight and sex and coming from the same lot were used as experimental and control individuals.

The tumor tissues were exposed to roentgen doses of 3, 6, 9, 12, 15, 18, and 21 Sabouraud and Noiré units *in situ* and *in vitro*, using a 2 mm. Al filter and a skin focus distance of 23 cm. It was found that 3 Sabouraud-Noiré units required 3½ minutes' exposure and corresponded to about 1 H. E. D.

In studying the effects of these dosages on

the transplanted tumors and on the hosts, only macroscopic measurements were used: (1) proportion of takes; (2) duration of animal's life after transplantation; (3) period of latency, and (4) rate of growth.

The author discusses the results with a rather full review of the literature. Illustrations and tables of findings are given to emphasize the text descriptions. However, no attempt was made to apply statistical criteria of significance in stating the results.

The lethal dose for the two tumors, both *in situ* and *in vitro*, was found to be 21 Sabouraud-Noiré units.

After doses of less than 9 s.-N. no appreciable difference in number of takes was noticed in the transplanted carcinoma, while the sarcoma gave a drop in percentage of takes after 3, 6 and 9 s.-N. When the dosage was increased to 12, 15 and 18 s.-N. the percentage of takes in the carcinoma fell to 23.8 while the takes in the sarcoma fell to 29.2 per cent.

Animals with the carcinoma transplants which were irradiated *in situ* showed an increase in average duration of life from 61 days after 3 s.-N. to 146 days after 15 s.-N. An observation which the author expresses inability to explain is that after 18 s.-N. there was a marked fall to 77 days average duration of life.

When irradiated *in vitro* the increase in duration of life was quite similar to irradiation *in situ*—61 days after 3 s.-N. to 143 days after 18 s.-N.

For the sarcoma the average duration of life for animals with the tumor irradiated *in situ* increased from 43 to 112 days; while those irradiated *in vitro* increased from 61 to 143 days after 18 s.-N.

From experiments in which the site was irradiated before transplantation, the animals showed an inhibitory effect toward growth of the carcinoma. A carcinoma implanted outside the site of irradiation was found to grow exactly as in a normal organism.

Roentgen irradiation of skin reduced the energy of growth of carcinoma transplants, reduced the number of takes and increased the average length of life of the animals. These

effects are most pronounced when the tumor is implanted intracutaneously.

In the case of the sarcoma there is a reduced growth energy but no reduction in the proportion of takes or increase in the average duration of life of the animals. The effect appears to be confined to tumor tissue growing in the cutis itself.

J. M. MURRAY

EXPERIMENTAL STUDIES ON ROENTGEN TREATMENT OF MALIGNANT TUMORS. (*Acta radiol., Suppl. IX.*) By Jens Juul. Paper. Price, Sw. cr. 8. Pp. 104, with illustrations, Stockholm: P. A. Norstedt & Soner, 1929.

The author gives detailed observations and discussion on experiments performed on white mice in which roentgen effects on two transplanted malignant tumors were studied from five different angles:

- (1) Effects of local irradiation with different doses;
- (2) Effects of general irradiation of the animals;
- (3) Difference in effect between single massive doses and repeated smaller doses;
- (4) Best effect on tumor, when skin effect is kept the same, between single massive doses and repeated smaller doses, and
- (5) Whether the saturation method gives a stronger effect on the tumor than these other methods when the skin effects are kept alike.

Radiation methods and a comprehensive review of previous work precedes each section of the experiment, while the author's own discussion follows his personal presentation.

The animal material and transplanted tumors are the same as those used by Krebs in his investigations on the interrelation between malignant tumors and their hosts after roentgen irradiation. Since the animals could not stand a dose of more than 6 Sabouraud-Noiré units on the region of thorax and upper abdomen, the technique of transplantation was changed to the introduction by cannula of a small piece of tumor to an epilated area at the base of the tail. The carcinoma successfully grew in 70 per cent while the sarcoma grew in 90-100 per cent of the animals. Growth of both tumors was rapid. Metastases to the lungs were observed with both tumors, the sarcoma metastasizing much more frequently than the carcinoma.

The radiation technique employed a ray of hard quality, 5 mm. Al being used. In a field  $10 \times 10$  cm., 1 H. E. D. for man was produced in 21 minutes. At 23 cm. focal distance 1 H. E. D. corresponded to 3.5 S.-N. Only macroscopic observations were recorded: (1) Tumor's rate of growth; (2) number of tumors that disappeared or percentage of takes, and (3) average of life in animals with persistent tumors.

Charts showing the details of tumor growths are given for each animal, the number of individuals being larger than in most experiments of this type. Since the animals were from a stock in which pedigree or exact age is not given, the significance in some instances is difficult to evaluate.

In the final section of this monograph the author gives a brief comparison of the experimental results and clinical experiences and emphasizes the following conclusions:

- (1) The dose should be as large as practicable without involving any serious injury to important adjacent organs or tissues.
- (2) Irradiation of large parts of the body with large doses of roentgen rays should be avoided.
- (3) Distribution of a dose over a longer time gives less effect than the same dose distributed over a short time.
- (4) The fractional or protracted irradiation should be preferred, however, as such treatment allows of a larger total dose and therefore gives a better therapeutic effect than can be obtained with the massive dose method.
- (5) The saturation method is preferable to the simple fractional method.

J. M. MURRAY

DIE RADIUMBEHANDLUNG IN DER AUGENHEILKUNDE. Von Dr. Leo Kumer, o.ö. Univ.-Prof., Innsbruck, Gew. ass. d. Univ.-Klinik f. Dermat. u. Syphil., in Wien (Vorstand Prof. Dr. L. Arzt), and Dr. L. Sallmann, Assistent der II. Universitäts-Augenklinik in Wien (Vorstand Prof. Dr. K. Lindner). Paper. Price, 14.40 Rm. Pp. 198, with 65 illustrations. Wien: Julius Springer, 1929.

This is a presentation of the use of radium in ophthalmology with special attention to clinical aspects. Principles of physics are discussed briefly, and technical problems and the action of radiation on the delicate ocular structures are given due consideration. The major part of the volume is devoted to pathological

conditions in and about the eye, the advisability of radium therapy, the dosage and the probable results as forecast by experience of the authors and others.

The text is interspersed freely with citations from the works of numerous authors and there is appended a list of several hundred references which seem to rather completely review the literature on the subject and is in itself a worthy addition to one's library.

Although the volume is concerned primarily with the use of radium, each case is considered on its merits, and if the experience indicates, roentgen therapy or a combined technique is recommended. The attitude of the authors is sufficiently conservative and their reasoning seems sound. Radiologists, ophthalmologists and dermatologists alike should find in the volume much of interest and value.

E. W. HALL

MEDICAL AND SURGICAL YEAR-BOOK OF THE PHYSICIANS HOSPITAL OF PLATTSBURGH. Comprising Wednesday Afternoon Invitation Lectures, Papers of the Cardiac Round Table, the First Beaumont Lecture, and Collected Papers by the Staff. Cloth. Price, \$3.50. Pp. 322, with 72 illustrations. Plattsburgh, N. Y.: The William H. Miner Foundation, 1930.

This book represents a collection of lectures and papers by guest lecturers and members of the Hospital Visiting Staff of the Physicians Hospital of Plattsburgh, N. Y., and published under the general direction of the Instruction Committee, composed of Harris A. Houghton, M.D., Chairman, Cassius D. Silver, M.D., Chief of Staff, and Irving S. Haynes, M.D. The activity which formed the basis of the collection of these papers was a summer course for the study of cardiorenal disease and arterial hypertension for undergraduate medical students about to enter the senior year in their several medical colleges. This course was intended as a supplement to the work of the medical school, and to offer increased facilities for physical ex-

amination and the study of patients. As a more formal part of the course, lectures and round table discussions were arranged, and the recording of these largely makes up the book.

The first section of the book is given over to seven invitation lectures by as many lecturers. Three of these lectures deal particularly with heart disease, two with pneumonia one with congenital syphilis, and one with the enterogenic factors in cardionephritic states.

The second section of the book is devoted to the "Cardiac Round Table" exercises, under fourteen titles by as many authors. The papers presented here show a wide interest in the study and management of heart disease.

The closing feature of the Cardiac Round Table was the "First Beaumont Lecture," and in addition to the physicians and students present, was attended largely by people of Plattsburgh who are interested in local history. This lectureship was established in honor of Dr. William Beaumont, "America's Pioneer Physiologist," who participated as a surgeon's mate in the land engagement of the Battle of Plattsburgh, and shortly after began the practice of medicine and surgery in this city. Some of his famous experiments on Alexis St. Martin were performed while he lived in Plattsburgh.

The Beaumont lecturer of 1929 was Dr. Walter R. Steiner of Hartford, Conn., who delivered an address on "Dr. William Beaumont, An Appreciation." At the close, a suitably inscribed bronze tablet (frontispiece), which had been placed on the west facade of the First National Bank building, the site where Dr. Beaumont began the private practice of medicine and surgery, was unveiled.

The last part of the book is occupied by a collection of fourteen papers on widely different subjects by various members of the Hospital Visiting Staff.

This work would indicate a high ideal and a great conscientious effort by a very admirable and creditable plan of extra-curricular teaching. The book itself is a splendid example of this type of publication.

CHARLES L. BROWN



THE CHEST. (*Annals of Roentgenology. Vol. XI.* Edited by James T. Case, M.D.) By L. R. Sante, M.D., F.A.C.P. Cloth. Price, \$20.00. Pp. 561, with 246 illustrations. New York: Paul B. Hoeber, Inc., 1930.

DISEASES OF THE SKIN. A Text-Book for Practitioners and Students. By George Clinton Andrews, A.B., M.D., Associate Professor of Dermatology, College of Physicians and Surgeons, Columbia University; Consulting Dermatologist and Syphilologist to Tarrytown Hospital; to St. John's Hospital, Yonkers; to Grassland's Hospital, and to the Broad Street Hospital, New York City. Cloth. Price, \$12.00. Pp. 1091, with 988 illustrations. Philadelphia and London: W. B. Saunders Co., 1930.

INTESTINAL TUBERCULOSIS: ITS IMPORTANCE, DIAGNOSIS AND TREATMENT. A Study of the Secondary Ulcerative Type. By Lawrason Brown, M.D., Consultant to the Trudeau Sanatorium, and Homer L. Sampson, Roentgenographer of the Trudeau Sanatorium, Saranac Lake, New York. Second edition, thoroughly revised. Cloth. Price, \$4.75. Pp. 376, with 122 engravings and 2 colored plates. Philadelphia: Lea and Febiger, 1930.

SELECTED READINGS IN THE HISTORY OF PHYSIOLOGY. Edited by John Farquhar Fulton, M.D., Formerly Fellow of Magdalen

College, Oxford; Sterling Professor of Physiology, Yale University. Cloth. Price, \$5.00. Pp. 317, with 60 illustrations. Springfield, Illinois: Charles C. Thomas, 1930.

NORMALE ANATOMIE DES KOPFES IM RÖNTGENBILD. I. TEIL. (*Radiologische Praktika, Band XII.*) Von Karl Goldhamer, Leiter des Röntgenlaboratoriums an der I. Anatomischen Lehrkanzel (Prof. Tandler) in Wien. Cloth. Price, M. 120. With 30 photographic plates, 30 illustrative schemas and 15 projection diagrams. Leipzig: Georg Thieme, 1930.

IODIZED OILS AS AN AID TO THE DIAGNOSIS OF LESIONS OF THE SPINAL CORD AND A CONTRIBUTION TO THE KNOWLEDGE OF ADHESIVE CIRCUMSCRIBED MENINGITIS. (*Acta radiol., Suppl. VII.*) By Martin Odin and Gosta Runstrom, in cooperation with Adolf Lindblom. Paper. Price, Sw. cr. 15. Pp. 86, with 4 figures in the text and 38 figures on 6 plates. Stockholm: P. A. Norstedt & Soner, 1922.

THE BEGINNINGS: EGYPT AND ASSYRIA. By WALTER R. DAWSON, F.R.S.E., Fellow of the Royal Society of Medicine, of the Society of Antiquaries of Scotland, and of the Royal Anthropological Institute of Great Britain and Ireland. Cloth. Price, \$1.50. Pp. 86. New York: Paul B. Hoeber, Inc., 1930.



# INDEX TO ABSTRACTS

## ROENTGEN DIAGNOSIS

### Head

- CHOBOT, ROBERT: The incidence of sinusitis in asthmatic children. . . . . 450
- JEANNENEY, G., AND WANGERMEZ, CH.: The rôle of the osseous structures in fractures of the cranium; a roentgen study. . . . . 450

### Neck and Chest

- MALNEKOFF, B. J.: Acute mediastinal abscess. . . . . 450
- AIRALE: Diverticulum of the esophagus which developed rapidly. . . . . 450
- BERGMANN, O.: On a modification of the procedure of measuring the diameter of the ascending aorta. . . . . 450
- HUET, J. A., AND DUVAL: Concerning the roentgen examination of certain processes of apical pleuritis. . . . . 451
- BARROS, ENRIQUE: Psittacosis. . . . . 451
- PATEY, D. H.: The effect of abdominal operations on the mechanism of respiration; with special reference to pulmonary embolism and massive collapse of the lungs. . . . . 451
- BARNES, HARRY L., AND BARNES, LENA R. P.: The duration of fatal phthisis. . . . . 452
- VON GLAHN, WILLIAM G.: Neoplasms of the lung. . . . . 452

### Abdomen

- SEGAR, LOUIS H., AND STOEFFLER, WALTER: Cardiospasm in the new-born infant. . . . . 453
- RUPP, ALICE, AND SCHULTZ, FREDERIC W.: Motility of the empty stomach in normal and in malnourished asthenic children. . . . . 453
- LEDoux-LEBARD, CALDERON, GARCIA, AND JAHIEL: A case of stenosis of the small intestine following gastroenterostomy. . . . . 453
- GRADO: Diverticula of the colon and appendices epiploica. . . . . 454
- SANTORO, MARIO: Busi's roentgen sign in ileoceco-colic invagination. . . . . 454
- GARGIULO, MARIO: The roentgen picture of the right colon in rapid emptying of the stomach. . . . . 454
- ANDERSON, JOHN H., AND MARKER, O. A.: Multiple polyposis of the colon. . . . . 454
- MIRIZZI, P. L.: Diagnosis of cystic tumors of the pancreas. Importance of roentgen rays and of the Wohlgemuth reaction. . . . . 455
- EPIFANIO, G.: The roentgenology of the peritoneum. Epiploitis and mesenteritis. . . . . 455
- VITA, GIULIO: Importance of pneumoperitoneum in differential diagnosis between

- cystoma of the ovary and the ascitic form of tuberculous peritonitis. . . . . 455

### Genitourinary System

- DEBENHAM, R. K.: A case of anomalous kidney producing symptoms. . . . . 455
- FUCHS, FELIX: Pyelovenous backflow in the human kidney. . . . . 456
- CAMPBELL, MEREDITH F.: Cystography in infancy and childhood. . . . . 457
- STEVENS, WILLIAM E.: Diseases of the urinary tract during infancy and childhood. . . . . 459
- BRAASCH, WILLIAM F.: Unusual types of urinary lithiasis. . . . . 460
- MCCARTHY, JOSEPH F.: A consideration of technique in the management of new growths of the bladder. . . . . 460
- DOSSOT, RAYMOND: Cancer of the prostate; its origin and extension. . . . . 461

### Nervous System

- LUDIN, MAX: Myelography. . . . . 462

### Skeletal System

- MILANI, EUGENIO: Osteogenetic exostosis of a familial type, associated in one case with bilateral dyschondroplasia. . . . . 462
- COPELAND, MURRAY M., AND GESCHICKTER, CHARLES F.: Ewing's sarcoma; small round cell sarcoma of bone. . . . . 463
- COPELAND, MURRAY M., AND GESCHICKTER, CHARLES F.: The nature of Ewing's tumor. . . . . 464
- CONNELL, W. W.: Thyroid metastases in bone. . . . . 465
- PHEMISTER, D. B.: Chondrosarcoma of bone. . . . . 466

### General

- CHIPMAN, ERNEST D., AND TEMPLETON, H. J.: Coccidioidal granuloma. . . . . 467
- MATUSOFF, IRVING: Congenital mirror picture dextrocardia with situs transversus, patent ductus arteriosus and subacute bacterial inflammation. . . . . 467
- BELOT, J.: A difficult case of expert medico-legal testimony; diagnosis corrected as a result of roentgen examination. . . . . 467
- SOILAND, ALBERT, AND MELAND, ORVILLE N.: Radiation service in the modern hospital. . . . . 468
- KNUTSSON, FOLKE: Danger of fire from roentgen films. . . . . 468
- GLOCKER, R.: The danger of film fires and the measures of prevention. . . . . 468

## ROENTGEN AND RADIUM THERAPY

- GALEWSKY, E., AND LINSEY, KARL: Experiences with dose measurement and filtration of roentgen rays in skin diseases. . . . 468
- ZUPPA, A.: Roentgen therapy in scleroderma 469
- BERING, FR.: On superficial roentgen therapy 469
- TRANIER: Treatment of cutaneous neoplasms in one single sitting with rays of medium penetration. . . . . 469
- GARGIULO, MARIO: Tuberculous iridocyclitis treated with roentgen rays. . . . . 469
- BIRKETT, G. E.: The radium problem. II. Radium treatment of buccal carcinoma. . 470
- SCHURCH, O.: What is essential for a successful therapy of carcinoma in the cavity. . . . 471
- COLA: The roentgen therapy of bronchial asthma. . . . . 472
- NICOTRA, A.: Cases of fibroangioma of the nasal cavity treated with roentgen therapy 472
- SMITH, GEORGE G., AND PEIRSON, EDWARD L.: The value of high voltage x-ray therapy in carcinoma of the prostate. . . . . 472
- WERNER, R.: The present status of roentgen therapy of cancer. . . . . 473
- KRAUSE, PAUL: A contribution to the knowledge of roentgen carcinoma as an occupational disease. . . . . 473
- LOCKHART-MUMMERY, J. P.: The use of radium in the treatment of rectal carcinoma 473
- BORAK, J.: The importance of radiotherapy in the treatment of Basedow's disease. . . 474
- FLORIN, MARIE: Curie therapy in the treatment of hemorrhagic metropathy of the menopause. . . . . 474
- NICOTRA, A.: Histological study of the uterine mucous membrane after roentgen castration. . . . . 474
- THIBAudeau, A. A., AND BURKE, E. M.: Carcinoma of the cervix uteri; an investigation of the relation between the histological findings and the results of radiation therapy. . . . . 474
- WASHBURN, ALFRED H.: Chloroma; report of a case with recovery following roentgenotherapy, with a review of the literature. . 475
- EPIFANIO, G.: Roentgen irradiation of the solar plexus. . . . . 476
- COLA: Attacks of hepatargia during roentgen treatment of Banti's disease. . . . . 476



## ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

### ROENTGEN DIAGNOSIS

#### HEAD

CHOBOT, ROBERT. The incidence of sinusitis in asthmatic children. *Am. J. Dis. Child.*, Feb., 1930, 39, 257-264.

Chobot believes that the incidence of sinus infection in asthmatic as well as in normal children is much higher than has hitherto been believed. In his series of 100 asthmatic children, 14 per cent had their first attack in the first year of life and 19 per cent in the second year, which figures compare closely with those of other observers. Fifteen per cent had negative skin reactions. The incidence of the age of onset of this group parallels that in hypersensitive patients. Fifteen per cent of the sensitive patients had their first attack in the first year and 23 per cent in the second year. Forty-one per cent of all patients, both sensitive and nonsensitive, had sinus infections, as shown by roentgen examination. He believes that treatment should be conservative, but puncture and irrigation should be carried out when conservative measures fail. The anatomy of the nasal passages, while making puncture difficult, at the same time enables many of the sinuses to drain spontaneously. Conservative measures such as shrinking down the mucous membrane, and simple nasal irrigation often suffice.—*R. S. Bromer*.

JEANNENEY, G., AND WANGERMEZ, CH. Le rôle de la structure osseuse dans les fractures du crâne (étude radiologique). (The rôle of the osseous structures in fractures of the cranium; a roentgen study.) *Presse méd.*, Feb. 26, 1930, 38, 284-285.

The most common fractures of the skull (fronto-sphenoidal, sphenopetrous, petro-occipital, as well as fractures of the pyramid) were studied by roentgenograms of dried specimens and it was found that the fracture always follows the line of least resistance.—*T. Leucutia*.

#### NECK AND CHEST

MALNEKOFF, B. J. Acute mediastinal abscess. *Am. J. Dis. Child.*, March, 1930, 39, 591-594.

Malnekoff reports a case of acute mediastinal abscess occurring in a child of twenty-one months who first developed an infection of the upper respiratory tract followed by an attack of measles. Three weeks after the onset roentgenograms showed a dense shadow lying well inside of the anterior mediastinum and outside the right lung. The child was hoarse, had a brassy cough, and complained of difficulty in swallowing. Repeated aspirations close to the sternum were made and the case went on to an uneventful recovery. Roentgenograms made eighteen months after the onset of the illness showed normal lungs and mediastinal shadows. Illustrations of the roentgenograms of the case show the appearance of the abscess shadow at the time the diagnosis was made, after aspiration and ultraviolet therapy, and eighteen months after the onset of the disease.—*R. S. Bromer*.

AIRALE. Diverticolo esofageo di rapido sviluppo. (Diverticulum of the esophagus which developed rapidly.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 207.

The author presents a case of large diverticulum of the precardiac part of the esophagus which had developed rapidly, for at an examination made two months before there had been no signs of it. The patient's symptoms at first were stomach symptoms but those he has now are esophageal. Diverticula of the lower part of the esophagus are unusual and it is very seldom that there is any such information as in this case in regard to the time required for the development of a diverticulum to such a size. The roentgenogram showed the diverticulum sharply circumscribed, irregularly conical in form and almost totally filled with the contrast medium so that no empty space was left above it. As such a finding in diverticulum is rare it suggests the possibility that the esophagus may have perforated and a sac have formed from reaction of the surrounding connective tissue.—*Audrey G. Morgan*.

BERGMANN, O. Sur une modification du procédé de mesure du diamètre de l'aorte ascendante. (On a modification of the pro-



cedure of measuring the diameter of the ascending aorta.) *Bull. et mém. Soc. de radiol. méd. de France*, Dec., 1929, 17, 285-286.

The roentgen estimation of the diameter of the ascending aorta encounters considerable difficulties on account of inability to accurately delineate the two borders simultaneously. In 1926 Reich called attention to the fact that the two borders are best visible 0.5 to 1 cm. underneath the bifurcation of the trachea, the patient being in an oblique position (near 45°). In rechecking this procedure the author found that it has considerable practical value and therefore she advises that it be used routinely. In some instances the sternal shadow interferes with good visibility of one of the borders but by a slight increase in the angle of rotation this can be easily overcome.—*T. Leucutia*.

HUET, J. A., and DUVAL. A propos de l'examen radiologique de certains processus de pleurites apicales. (Concerning the roentgen examination of certain processes of apical pleuritis.) *Bull. et mém. Soc. de radiol. méd. de France*, Feb., 1930, 18, 76-79.

Seven cases of apical pleuritis were observed in the course of 400 chest examinations.

The conclusion is reached that the roentgen diagnosis of apical pleuritis belongs to the rarest occurrences and that an accurate diagnosis can be made only in conjunction with certain clinical findings. Its detection is important for two reasons: (1) it leads to an early diagnosis of apical tuberculosis, and (2) it permits certain estimations with regard to the indication of an artificial pneumothorax.—*T. Leucutia*.

BARROS, ENRIQUE. La psittacose. (Psittacosis.) *Rev. sud-amér. de méd. et de chir.*, March, 1930, 1, 225-235.

Eighty cases of psittacosis were observed at Cordova and it was found that many of these presented changes within the chest which could be classified as follows: (a) pneumonic forms; (b) forms with congestion of the bases; (c) corticopleuritis; (d) bronchopneumonias of prolonged duration, and (e) forms of hepatization. The roentgen examination is of considerable aid in these instances.

In a manner similar to the grip, pneumonia and bronchopneumonia were responsible for the rather large mortality in psittacosis.—*T. Leucutia*.

PATEY, D. H. The effect of abdominal operations on the mechanism of respiration; with special reference to pulmonary embolism and massive collapse of the lungs. *Brit. J. Surg.*, Jan., 1930, 17, 487-497.

Patey states that it is a well-established fact that operations on the abdomen are definitely more liable than surgical procedures in the other parts of the body, to be followed by two types of complication: (1) pulmonary embolism and thrombosis, and (2) collapse and inflammatory affections of the lung bases.

His statistics, as well as those of previous authors, show that pulmonary embolism and thrombosis follow operations upon all parts of the abdomen and are not more prone to occur in those involving the upper portion only. The occurrence of these complications certainly is much greater following abdominal operations than in extra-abdominal procedures. Collapse and inflammatory affections of the bases of the lungs also show a special tendency to follow operations. The latter seem to be dependent on interference in some way with the mechanism of respiration, either directly or indirectly. Thus pain because of the incision, may prevent the patient from taking a full breath. In observations Patey found there was a definite fall in vital capacity in patients having incisions in the abdominal wall. There is also a reduction in the amount of air expired with each normal respiration and he also concludes from roentgen studies, that the respiratory excursions of the diaphragm are diminished. Suggested means of combating the diaphragmatic inhibition are postoperative deep-breathing exercises, inhalations of CO<sub>2</sub> gas as a routine after operation, attempts to diminish pain by means such as the use of novocaine and other local anesthetics, the administration of morphine, etc. These have not proved entirely satisfactory and the problem is really unsolved.

In an investigation of the percentage of carbon dioxide in the alveolar air, Patey noted that the readings on the second day following operation were lower as compared with the preoperative readings. The reasons for this he believes are the following: (1) the abdominal muscles being interfered with in respiration, they are unable to express the air so completely from the lungs as in normal cases, and (2) the greater tendency of the injured musculature to tire. In regard to intraabdominal respiratory variations of pressure, he

found that in postoperative cases as a rule there were: (1) less regularity of the postoperative curve; (2) the undulations of quiet respiration are diminished, and the amplification on deep breathing is much lessened; (3) the secondary curve of late expiration, if present before operation, is either greatly diminished or disappears. If an abdominal incision disorganizes the intraabdominal pressure, venous stasis results. Thus abdominal massage that reproduces the normal abdominal pump mechanism should theoretically be of assistance in overcoming this stasis and facilitate venous return. Other helpful measures would be, combating postoperative distention of the abdomen, and firm support in splinting the injured abdominal musculature.

He concludes that any influence, that interference with respiration has, is of a predisposing nature only, and that other factors are necessary for the development of the above complications.—*R. S. Bromer.*

BARNES, HARRY L., and BARNES, LENA R. P.  
The duration of fatal phthisis. *Am. Rev. Tuberc.*, Dec., 1929, 20, 895-900.

A statistical report from the State Sanatorium, Wallum Lake, Rhode Island. Out of 8,425 cases admitted to the Sanatorium in the years 1905 to 1926 inclusive, 2,537 who died of phthisis afforded data sufficiently satisfactory to be available for this study.

The average duration of life for the 2,537 patients was 36.72 months. For the males in this group the average duration was 37.93 months, females, 34.81 months; white patients of which there were 2,424—37.81 months and 111 colored patients—19.59 months. Patients with hemoptysis lived longer than those without hemoptysis. Of 51 patients with a history of pleurisy with effusion, if the onset be dated from the onset of pleurisy, the average duration of life was 51 months, while if the duration was taken from the onset of continuous pulmonary symptoms the duration was but 37 months.

Various observers have recorded the duration of fatal phthisis from time to time and it is to be noted that the figures given correspond very closely to those offered in this present research.

The authors point out the difficulty in such a study especially as to the determination of the onset of tuberculosis. The insidiousness

of the disease makes it difficult for the patient to state accurately the onset of symptoms. Other factors influencing the duration of life in pulmonary tuberculosis are the financial circumstances of the patients, and the selection of patients for institutional care as regards the stage of the disease when admitted.

Obviously such a study as this is of considerable importance from medical and economic standpoints.—*Karl Kornblum.*

VON GLAHN, WILLIAM G. Neoplasms of the lung. *Am. Rev. Tuberc.*, Jan., 1930, 21, 57-69.

A discussion is given of neoplasms of the lung containing a brief reference to such rare tumors as congenital cysts, congenital adenomata and chondromata. More refined histological methods have shown that sarcomata, once regarded as fairly common, are in reality uncommon.

Carcinoma forms the largest group of pulmonary neoplasms. Reference is made to the work of various investigators who have attempted experimentally to produce tumors in the lungs of animals, hoping in this way to learn something as to the possible etiology of lung tumors. Some of the etiological factors considered in human pulmonary neoplasms are inhalations of radioactive dusts and dusts from tarred roads, inhalations of irritant gases, tobacco smoke and industrial dusts, overgrowth of epithelium following influenza and lung changes in chronic tuberculosis. Metaplasia of the bronchial epithelium in chronic bronchitis and bronchiectatic cavities is believed to favor the growth of a tumor.

Carcinoma of the lung occurs more frequently in males than in females, the ratio being about 3 to 1. The incidence is highest between the ages of fifty and seventy.

The usual sources from which tumors arise are the bronchial and alveolar epithelium and bronchial glands. A primary bronchus is the most frequent site of the origin. The right lung is slightly more often involved than the left. Metastases are often widespread.

The more usual types of pulmonary carcinomata are illustrated by case reports with autopsy findings. No roentgenograms are included. Examples are given of carcinoma arising from primary bronchi, in tuberculous foci, from alveolar epithelium and in a bronchiectatic cavity.

The paper is concluded with a discussion of the incidence of pulmonary carcinoma. Statistics from various hospitals both abroad and in this country are given. Some of these show an increase in incidence in recent years while others fail to show any change in the incidence. The author states that his study of the available statistics leaves him in doubt as to whether there has been an actual increase of lung carcinoma.—*Karl Kornblum*.

#### ABDOMEN

SEGAR, LOUIS H., and STOEFFLER, WALTER. Cardiospasm in the new-born infant. *Am. J. Dis. Child.*, Feb., 1930, 39, 354-359.

With the exception of one previous report, the authors state that they have found no case reports of the occurrence of cardiospasm in infants. Two cases seen by them within a short time suggest that its occurrence may be less rare than is commonly supposed.

They report 2 cases of vomiting occurring in new-born infants. This occurred immediately after a few swallows of any fluid were taken, milk being unchanged in character. Dysphagia and discomfort were noted just before vomiting occurred. In the first case, one ounce of barium mixture was taken without regurgitation. After 2 or 3 swallows which went directly into the stomach, there was definite stasis in the esophagus which remained for an hour. At 18 hours the esophagus and the stomach were empty. In the second case, the roentgenogram made after the ingestion of the meal showed barium in the esophagus and the stomach, occupying the lower end of the former and tapering down to a fine point at the cardia. One hour later the barium still remained in the lower end of the esophagus.

The authors comment on the various theories of the cause of cardiospasm, and believe that the stenosis in their cases was apparently due to a temporary incoordination of the deglutitory cycle.—*R. S. Bromer*.

RUPP, ALICE, and SCHULTZ, FREDERIC W. Motility of the empty stomach in normal and in malnourished asthenic children. *Am. J. Dis. Child.*, Feb. 1930, 39, 241-256.

Most investigators who have studied gastric motility in children have made use of the methods of gastric expressions and roentgen examination chiefly for the determination of the emptying time of the digesting stomach.

The authors state that such studies are limited by the fact that the examinations are brief and are made only at certain intervals, so that it is impossible to obtain a continuous record of gastric activity.

As activity of the stomach is somewhat variable, they thought that a continuous examination over an extended period might yield valuable information with regard to the inherent power of the gastric musculature under certain conditions. Their paper deals with motility of the empty stomach in normal children, and in those who are of the asthenic body habitus and in a malnourished condition, being underweight for the age and height. Their study includes 5 normal and 14 asthenic children.

The method employed was that of Carlson: A deflated balloon was attached to one end of a rubber tube and was swallowed by the subject, the other end of the tube being connected with a manometer fitted with a lever, arranged in such a manner that a graphic record was obtained on smoked paper mounted on a moving drum. When the balloon was inflated at the beginning of an experiment, the pressure changes due to the contractions of the stomach were recorded. The advantage of this method lay in the fact that a continuous record of the activity over a long period of time could be obtained.

They conclude that gastric activity during hunger in children is intermediate in degree between that in the new-born infant and that in the adult. The activity of the empty stomach is decreased in malnourished asthenic children in comparison with the normal, and is still further decreased in those with certain gastrointestinal complaints. No explanation for this decrease in activity is offered as yet.—*R. S. Bromer*.

LEDOUX-LEBARD, CALDERON, GARCIA, and JAHIEL. Sur un cas de sténose du grêle après gastro-entérostomie. (A case of stenosis of the small intestine following gastroenterostomy.) *Bull. et mém. Soc. de radiol. méd. de France*, Feb., 1930, 18, 74-76.

A stenosis of the jejunum, localized to the efferent part of the gastroenterostomic stoma, is described in a man forty years of age. Soon after the gastroenterostomy the digestive disturbances recurred and a roentgen examination made several months later revealed a

peculiar image, first giving the impression of a biloculation and later (after the filling of the dilated ends above the stenosis) of a triloculation of the stomach.

Following operation, which consisted in a jejuno-jejunostomy, there was healing, lasting now for a period of over a year.—*T. Leucutia.*

GRADO. Diverticoli del colon ed appendici epiploiche. (Diverticula of the colon and appendices epiploicae.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 228.

The author presents the case of a woman with a soft fluctuating swelling in the right iliac fossa accompanied by fever and pain which on roentgen examination was found to involve the right adnexa. The examination also showed many diverticula along the transverse colon which the author believes were insinuated into the appendices epiploicae. He describes the mechanism of their formation and concludes by saying that in addition to other factors in their production, they are caused by the arrangement of the muscle fibers of this tract of the intestine and the gaps in the peritoneum represented by the appendices epiploicae.—*Audrey G. Morgan.*

SANTORO, MARIO. Nuovo sintoma radiologico di Busi nella invaginazione ileo-ceco-colica. (Busi's roentgen sign in ileo-ceco-colic invagination.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 207-224.

Three cases of ileo-ceco-colic invagination are described in which the author saw the roentgen sign described by Busi in 1926. It consists of a series of more or less complete rings caused by the contrast liquid infiltrating between the walls of the invaginated and invaginating parts of the intestine and accumulating in the haustra of the invaginating part. This sign is obtained by giving barium by mouth. It is always advisable to begin with the administration of barium by mouth and not give an opaque enema until afterward. The 3 cases were operated on and no changes found in the walls of the intestine, so apparently spastic contraction of the cecal sphincters is of great importance in causing this disease.—*Audrey G. Morgan.*

GARGIULO, MARIO. Il quadro radiologico del colon destro nello svuotamento rapido dello stomaco. (The roentgen picture of the right

colon in rapid emptying of the stomach.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 183-206.

The author gives illustrative roentgenograms showing that the changed chemism of the stomach in rapid emptying causes slight lesions in the right colon which, while they do not increase to such an extent as to cause a true colitis, yet give a roentgen picture that is very much like that of ulcerous colitis.—*Audrey G. Morgan.*

ANDERSON, JOHN H., and MARKER, O. A. Multiple polyposis of the colon. *Brit. J. Surg.*, Jan., 1930, 17, 451-455.

The authors report 2 cases of ulcerative colitis with multiple polyposis of the colon. They state that the difficulty lies in the diagnosis of multiple polyposis and as the symptoms are those of ulcerative colitis, the sigmoidoscope and the roentgen ray offer the only means of recognizing the condition short of opening the abdomen and the colon. Unless the roentgenologist is warned of the presence of colitis, the polyposis may be missed, owing to the rapid passage of the meal through the colon. Frequent examinations are necessary, and the general routine of the barium meal may require considerable modification. In some cases the barium enema was given fifteen minutes after a hypodermic of morphia gr. one-sixth, and atropine sulphate, gr. one-hundredth. The material was run in at low pressure (18 in.) with the foot of the couch raised and the patient prone.

In polyposis the filled bowel is studded with concave impressions on the otherwise smooth margin, and the mucosa in general presents a mottled or honeycomb appearance, probably due to only a thin coating of opaque material being present in parts, owing to the displacement by the polypi. If the bowel is too distended to show this mottling, pressure with a wooden spoon or airbag may produce it. Serial films showed some exaggeration of the lesser movements of the colon, but frequent incomplete mass movements were present with a slowing of the relaxation phase and absence of segmentation. The nodular filling defects at the margins of the filled bowel and the honeycomb appearance of the colon as a whole are the main features in excluding uncomplicated colitis.

Polypi of the colon are of two types, inflammatory and true tumors, the latter being more



frequently encountered. The authors feel that it is uncertain whether inflammatory polypi can be diagnosed roentgenographically due to the fact that inflammatory polypi are strips of mucous membrane which have become detached along almost their whole length, due to the undermining character of the ulceration.—*R. S. Bromer.*

MIRIZZI, P. L. Diagnostic des tumeurs kystiques du pancréas. Importance des rayons X et de la réaction de Wohlgemuth. (Diagnosis of cystic tumors of the pancreas. Importance of roentgen rays and of the Wohlgemuth reaction.) *Rev. sud-amér. de méd. et de chir.*, March, 1930, 1, 236-246.

Four cases of pancreatic cysts are briefly described and—in addition to the value of the Wohlgemuth reaction in urine—the importance of the roentgen findings is discussed.

One of the chief roentgen signs in pancreatic cysts is the deformity produced on the stomach. If the cyst involves the gastroduodenal ligament the pressure is mainly on the greater curvature, often leading to obliteration with inversion of the lesser curvature, while if the cyst originates within the lesser omentum, the pressure is chiefly on the lesser curvature, leading to the so-called hour-glass appearance.—*T. Leucutia.*

EPIFANIO, G. La radiologia del peritoneo. Epiploitis and mesenteritis. (The roentgenology of the peritoneum. Epiploitis and mesenteritis.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 227-228.

The author presented a hundred roentgenograms showing many clinical cases of epiploitis and perivisceritis. They occurred in various inflammatory and ulcerative conditions of the abdominal organs. They are brought about by the protective and plastic function of the peritoneum which is developed to the highest degree in the great omentum; when an inflammatory or ulcerative process or a simple circulatory disturbance effects one or more of the abdominal organs the peritoneum which surrounds them, the meso which suspends them and the omentum which unites them like a bridge, all take part in the inflammatory process, bringing about perivisceritis, mesenteritis and epiploitis, which after an acute phase tends to pass into a chronic condition with a tendency to acute exacerbations. These local fibroplastic chronic inflammations tend to per-

petuate the disturbance in the organ in which it originated and complicate the clinical picture. The author shows that the roentgenology of the peritoneum is an important chapter in clinical roentgenology.—*Audrey G. Morgan.*

VITA, GIULIO. Importanza del pneumoperitoneo nella diagnosi differenziale fra cistoma ovarico e peritonite tuberculare forma ascitica. (Importance of pneumoperitoneum in differential diagnosis between cystoma of the ovary and the ascitic form of tuberculous peritonitis.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 224-226.

A case is described in a patient aged twenty, with no family or personal history of any importance, who for two years had noticed a progressive increase in the size of her abdomen. She did not have fever. Recently she had had serious heart and respiratory disturbances on account of the increased size of the abdomen. A noted clinician and an equally noted surgeon both made a diagnosis of tuberculous peritonitis but treatment for that condition did no good and the patient was sent to the author for roentgen examination. It showed the diaphragm displaced upward with reduced size of the lung fields. The stomach was displaced upward and emptied in normal time. There were no anatomical defects and no special pain. The small intestine was pushed upward and laterally. The cecum and ascending colon were pushed upward beneath the costal arch. There was evidently intra-abdominal tension that pushed the viscera upward. Such a displacement could not have been caused by free liquid. A diagnostic pneumoperitoneum with oxygen was practiced to clear up the diagnosis. Two liters of oxygen were injected into the abdominal cavity and a roentgenogram taken. It showed that the intra-abdominal pressure was caused by a mass that displaced the viscera upward. Operation confirmed the diagnosis and an enormous multilocular ovarian cystoma was removed that weighed about 5 kilograms.

Pneumoperitoneum is of great value in this differential diagnosis in which mistakes are often made.—*Audrey G. Morgan.*

#### GENITOURINARY SYSTEM

DEBENHAM, R. K. A case of anomalous kidney producing symptoms. *Brit. J. Surg.*, Jan., 1930, 17, 557-560.

Debenham reports a case of anomalous kidney, quoting statistics of the frequency of the different forms of renal anomalies. His case produced symptoms at the age of thirty-three, and was associated with hydronephrosis. The diagnosis lay between carcinoma of the colon and a renal swelling, a pyelogram having been most useful in deciding the question. A roentgenogram of the urinary tract first made, was negative, the right kidney being normal in size. A barium enema of the colon showed no abnormality in the colon. On cystoscopy the bladder and ureteral orifices were normal. A pyelogram of the left kidney pelvis showed considerable rotation of the kidney on its axis, so that the ureter emerged from the pelvis on the outer side. A diagnosis of hydronephrosis was made. The right kidney showed a normal pyelogram. On operation the left kidney was found to be low, lying partly in the left iliac fossa. The specimen showed that the main renal vein left the kidney at the hilum, which was on the anterior surface. A small artery entered the hilum at the upper part, but the main arterial supply entered the posterior surface of the kidney, one and possibly two vessels coming from the left common iliac artery. One small artery with a large vein passed behind the posterior surface of the kidney, curved around the outer side, and entered the hilum on its external aspect; these vessels appeared at the operation to be constricting the kidney about its center.

Debenham regards this as a very rare congenital condition.—*R. S. Bromer.*

FUCHS, FELIX. Pyelovenous backflow in the human kidney. *J. Urol.*, Feb., 1930, 23, 181-216.

*I. Scope of Problem, Report on Literature and Animal Experiments.* The object of this communication is a consideration of pyelovenous backflow, the particular anatomical and hydromechanic peculiarities of which should be established. If one injects fluid into the ureter of a human or animal kidney after removal, the fluid often flows out by way of the renal veins, because of a direct connection between the vascular system and the upper portions of the kidney pelvis. An attempt to establish the practical significance of this phenomenon has been made through animal experiments. Exactly the rôle that the pyelo-

venous backflow plays in human pathology is the specific object of this paper.

A short survey of the literature, from the first observations of Gigon, 1856, up to the present time is given. Some of the more important points regarding pyelovenous backflow accumulated by different authors are considered. Among these are:

1. The fate of fluid forced under pressure into the kidney pelvis through the ureter. Experimental evidence has shown that such fluid is found in all the tissue elements of the kidney, mostly in the lymph spaces and blood vessels, especially the veins, and least in the uriniferous tubules.

2. The mechanism of the passage of fluid from the kidney pelvis into the veins, as well as into the lymph vessels and uriniferous tubules. Summing up the experimental and anatomical findings it may be said that pyelovenous backflow is accomplished by direct communication between the pelvis and venous system, initiated by rupture of the kidney pelvis.

3. The pressure necessary to produce pyelovenous backflow. According to all investigators this pressure is exceptionally small. No difference was found in the required pressure between cadaverous and living kidneys.

*II. The Author's Investigations on the Kidneys of Human Cadavers.* While there are certain well-recognized differences between the intrarenal topography of the kidneys of mammals and the human, yet in spite of these differences, there are important analogies in the pyelovascular mechanism.

It may be deduced from the investigations of Hinman, Lee-Brown, that the place of pyelovenous backflow is at the apex of a minor calyx, called the fornix calyces in the human kidney. The author has shown by means of a macerated preparation the relation between the fornix calyces and the venous plexus of the renal sinus. He found three-fourths the circumference of the fornix calyces often surrounded by a venous plexus. It is thus clear that the venous circulation in the calyx must sustain considerable injury in event of expansion of the calyx.

The kidney pelvis is regarded as the strongest ductile segment of the upper urinary passages, while the kidney parenchyma lacks an extensive ductility. It is apparent\* that the

line of separation between the weak and strong parts of the pelvic cavity is at the point of insertion of the calyx in the kidney parenchyma, namely, at the fornix calyces. This is the place of predilection for rupture in the case of internal pressure.

For the purpose of observing the conditions of rupture of the venous system from injected fluid, the author injected normal human kidneys of different ages and as fresh as possible, with 20 per cent sodium bromide solutions. The injections were watched fluoroscopically. The passage of the fluid from the pelvis into the venous channels was accurately noted.

The same phenomenon was studied by means of the corrosion method in which celluloid dissolved in acetone was injected into the ureter until the injection mass appeared at the stump of the renal vein. By this method it was shown that the veins were filled by an extravasation from the fornices calyces.

In spite of these observations it was still not clear whether the fluid which left the pelvis at the fornix calyces, actually entered the surrounding vein stems, and still much less clear why this should be the case. Answers to these questions were obtained by further and more minute study of the anatomical relations of the venous system of the kidney. It was found that an artificial perivenous space was created when the veins were forced away from the adjacent kidney parenchyma by the extravasated fluid from the ruptured fornix calyces. This forceful separation of the vein stem from the parenchyma caused a stretching and rupture of the many small venules emerging from the parenchyma to enter the veins. These ruptured venules thus permitted a direct communication for the passage of the extravasated fluid from the perivenous spaces into the veins.

It is probable that other forms of extravasations, such as subcapsular and sinus-hilus extravasations, which are considerably less frequent than pyelovenous backflow, also result from rupture of small vessels leading to the various types of veins to be found in close relationship with the kidney pelvis.

*III. Conclusions for Human Pathology and Clinic.* A number of investigators have attributed pyelovenous backflow to a direct penetration of the papillary duct openings of the papillae. The author, while never able to demonstrate this himself, admits its possibility in rare instances and then only at very high pressures.

The pressure at which pyelovenous backflow occurs and whether such pressures occur spontaneously are important questions. It is shown that in renal colic there is an increase in intrapelvic pressure of the kidney and that this pressure is of the same nature and actually exceeds that produced during pyelographic filling of the pelvis. The question is whether these higher pressures cause pyelovenous backflow.

There are two ways by which it may be shown when pyelovenous backflow occurs in humans: (a) direct observation by pyelography; (b) the reaction of the organism to pressure increases in the kidney pelvis due to artificial or spontaneous causes.

In carefully done pyelographies injections are stopped as soon as the patient complains of pain. The abnormal shadows sometimes seen about the calyces in pyelograms represent the initial stages and not the actual pyelovenous backflow as studied experimentally.

Of more practical importance is the greater pressure produced in the kidney pelvis during attacks of colic. In such attacks symptoms of infection are common. Under such circumstances the author states, "that the septic fever curve in the temperature course of patients with congestion and infection of the urinary passages should always be considered as the clinical expression of pyelovenous backflow waves."

Attention is called to the fact that rupture of veins occurring in pyelovenous backflow may be the source of hemorrhage in such conditions as intermittent hydronephrosis and colic associated with pelvic or ureteral calculi. It is possible that pyelovenous backflow may open the way for ascending infections of the kidney parenchyma.—*Karl Kornblum.*

CAMPBELL, MEREDITH, F. Cystography in infancy and childhood. *Am. J. Dis. Child.*, Feb., 1930, 39, 386-402.

Campbell states that two factors in particular account for the fact that cystography has been scantily employed in pediatric cases: (1) lack of appreciation both of the potential diagnostic value of cystography and of its technical simplicity; (2) failure of physicians to seek urologic advice and aid in caring for young patients having obvious disease of the urinary tract. A normal cystogram will be obtained in a great many cases, but, on the

other hand, a certain number will show striking evidence of urologic disease, and with surprising frequency properly interpreted cystograms alone will suffice to establish the correct diagnosis. This paper is based on 150 pediatric cases in which cystography or pyelography was performed.

Cystography is indicated in all cases of urologic disease in infants and children except where an acute infection of the urinary tract is present. Most cases of urinary infection clear up in from two to four weeks irrespective of therapeutic efforts. He believes that all children with persistent pyuria after four weeks of proper medical care should be subjected to a thorough urologic examination. The more longstanding the urinary disease, the greater will be the likelihood of obtaining abnormal cystograms. Cystography is useful also in all neurogenic disturbances of the bladder, and into this group fall a large proportion of the patients commonly designated as enuretic. Many neurogenic cases have a chronic pyuria. Further indications for its use are: a palpable suprapubic mass, evidence of vesical retention, persistent urinary frequency, difficulty, dysuria or vesical pain in children. Hematuria when not due to hemorrhagic nephritis always warrants cystography and usually ureteral catheterization and pyelography as well. Campbell has never felt that age was a contraindication. His youngest patient was six days old, and one in six of his patients was less than one year of age.

He describes the technique of cystography very fully. From a roentgen standpoint, preliminary clearing of the intestinal tract is advised, an enema being preferred. The roentgen tube should be over the pubis and directed toward the bladder, so that the vesical outlet will be shown on the films. This is of particular importance in cases of neuromuscular vesical disturbances which are so frequently characterized by a funnel-shaped vesical outlet indicative of internal sphincter relaxation. In young children, the Potter-Bucky diaphragm cannot be used and "flash" exposures must be made between respirations.

The conformation of the normal cystogram varies greatly; the degree of filling is the most important factor. The well-filled bladder is round, oval or pyriform. An uncompressed, partially filled viscus will appear as a kidney-shaped shadow, just as the bladder which is

compressed by a low intraabdominal mass. With incomplete filling the bladder dome has a square appearance. If the hips are not squarely on the film (pelvic rotation), the normal bladder usually assumes a direction toward the urachus. Normally, the vesical outlet is not evident on the film; the outline of the lower segment of the bladder is sharply defined. Normally, no ureteral reflux is present. In approximately one-third, 43 cases, of this series a normal cystoscopic picture was found to accompany a normal cystogram. In three-fourths of these, ureteral catheterization revealed infection of the upper urinary tract; obviously, this infection had not involved the uretero-vesical valves. On the other hand, no case was encountered that showed an abnormal cystogram when the cystoscopic observations were normal.

Because of the variety of forms of the normal cystogram, the recognition of the abnormal is sometimes difficult. The diagnosis of a normal bladder contour should be made with considerable latitude. Infection of the bladder wall of marked intensity or of long duration is frequently manifested in the cystogram by a fuzziness or moth-eaten irregularity of the bladder outline, and in this way severe localized mural cystitis may sometimes be diagnosed by the cystogram. With marked cystitis, ureteral reflux will often be noted on one or both sides depending, of course, on the degree of involvement of the uretero-vesical valves. Diverticulosis is indicated by characteristic outpocketings from the wall of the bladder. To demonstrate these, it is advantageous to make roentgenograms from several different angles. Stereoscopic roentgenograms are also useful. Refilling with air, after emptying the bladder of opaque solution, will also assist in demonstrating diverticula and will also show any stones that fill them. Ureteral reflux is due to damage of the uretero-vesical valve mechanism, usually brought on by infection, less often by neuromuscular disease or obstructions of the lower tract with resultant back pressure, aided as a rule by infection. Reflux may extend up the ureters to the kidney pelvis and so obviate the necessity of pyelography. Campbell has never observed reflux in a normal bladder. Previous reports of reflux in normal bladders were found in cases in which cystography was performed under general anesthesia. Gruber has shown that when normal



bladders of anesthetized animals are distended under abnormally high pressure, reflux occurs in some instances. Campbell believes that in his cases which were not done under general anesthesia, normal anatomical considerations prevail and reflux does not occur. In certain cases, the etiologic factor causing reflux must be considered as congenital. In 4 cases seen at autopsy, proof of congenital origin, probably neuromuscular, was obtained. Hypotonia or functional atony of the uretero-vesical valves is sometimes the cause of reflux. Or it may result from back pressure caused by the chronic sphincterospasm of neurogenic vesical disease. Campbell has noted enormous distention of the bladder in choreic children. He has only once observed ureteral reflux in children due to uretero-vesical tuberculosis, secondary to renal disease. On the other hand, non-tuberculous infections are very common and in these reflux is often observed. Reflux is of great clinical importance as by this means, dissemination of urinary infection is greatly aided. Helmholtz believes that reflux is of more importance than any other factor in the production of renal infection in the very young. Normal function of the valves may be resumed upon the subsidence of infection, and fortunately reflux from an infected bladder does not always cause immediate renal infection. It cannot be demonstrated conclusively without cystography. Campbell does not believe that spastic contracture of the bladder musculature is a common cause of ureteral reflux. Obstructions of the lower urinary tract are occasionally observed in infants and children, and are of congenital origin in nearly all cases. Congenital contracture of the vesical outlet or congenital valves of the posterior urethra, and chronic sphincterospasm due to the "cord bladder" caused by myelitis, etc., are the most common forms of obstruction of the lower urinary tract. Rarely is obstruction due to urethral stricture found in childhood. Intravesical growths are so uncommon in childhood that they warrant scant comment. They are indicated by moth-eaten-appearing filling defects of the bladder cavity. Extravesical neoplasia or inflammatory masses may compress the bladder but these also are of rare occurrence.—*R. S. Bromer.*

STEVENS, WILLIAM E. Diseases of the urinary tract during infancy and childhood. *J. Urol.*, Jan., 1930, 23, 61-80.

A plea for a more thorough investigation and treatment of urologic conditions occurring in infants and children. Attention is called to the fact that these conditions are more frequent than is generally appreciated. A closer cooperation between the general practitioner, the pediatrician and urologist is urged.

The same methods employed in adults can be used in the management of urologic problems in children. Certain practical points are emphasized such as the use and choice of anesthetics and the types of cystoscopes and ureteral catheters to be employed.

Some of the more common conditions encountered in children are dealt with. Case reports are cited accompanied by illustrations of pathologic specimens and roentgenograms. Considered under this heading are anomalies of the urinary tract which are not uncommon. The statistical reports of various writers are quoted to indicate the incidence of anomalies.

The paper is based upon a review of the histories of 9115 clinic patients admitted to the pediatric department of Stanford University Hospital. Of this number, 205 suffered from one or more pathologic conditions of the urinary tract. There were 106 males and 99 females. Pyelitis, under which classification pyelonephritis and pyelocystitis were included, occurred in 74 instances, nephritis in 35, phimosis in 28, undescended testicle in 13, urethral stricture in 5, nephrolithiasis in 3, redundant prepuce in 3, hydroceles in 4, tuberculosis of the kidney in 2, trigonitis in 2, anomalies in 2, neuromuscular dysfunction of the kidney in one, abscess of the penis in one, polycystic kidney in one, tumor of the kidney in one, stricture of the ureter in one, hydroureters in one and urethritis in one.

Pyelitis is the most frequent urologic condition in female infants and children. It was found  $4\frac{1}{2}$  times more frequently in females than males. While a certain number are self limited many cases require ureteral dilatation and irrigation of the pelvis. These procedures are indicated if no improvement follows a week of conservative treatment, or earlier if the patient is very ill or is rapidly going downhill.

Hydronephrosis and hydroureters, frequent in children, are usually due to congenital strictures of the ureter or urethra.

Tuberculosis of the kidney is relatively uncommon. Bilateral involvement is more fre-

quent in children than adults. This condition is usually rapidly fatal. Early diagnosis is obviously of the greatest importance.

Urethral strictures of congenital origin are not uncommon in both sexes. They occur more often at the external meatus. They respond readily to dilatation. The author believes that improvement of many urinary conditions has often been due to dilatation of an overlooked urethral stricture by the cystoscope.—*Karl Kornblum*.

BRAASCH, WILLIAM F. Unusual types of urinary lithiasis. *J. Urol.*, Jan., 1930, 23, 1-12.

The clinical aspects of various types of unusual urinary calculi are discussed. The first described is the so-called pseudolithiasis or "hysterical lithiasis" observed in individuals who for one reason or other deceptively produce calculi at will. The records of the Mayo Clinic show that 9 such patients have been observed, 8 of them women. Drug addiction is sometimes the cause for such deception. One of the patients whose case history is given had a small bag of pebbles which she would place, when not observed, in the region of the kidney when roentgenograms were made for detection of calculi. The stones which most of the patients carried about with them could easily be recognized as foreign substances from their appearance, although in some instances chemical analysis was necessary to reveal their identity. The patient confronted with such an analysis usually admitted the deception. One should be suspicious of pseudolithiasis in cases of oft-repeated passage of stone and a chemical analysis of such calculi should be made.

A case is reported of a ureteral calculus containing a needle which the patient had introduced into the bladder and which had evidently been regurgitated into the ureter.

Semi-calcified bodies, which are not true calculi are occasionally present in the kidney. The three types most commonly observed are putty-like formations, masses of sandy material and semi-organized blood clots with calcareous deposits. The putty-like formations vary in size and shape and are usually multiple. They may contain only a small amount of calcareous material and for this reason may cast only faint or irregular shadows on the roentgenogram, sometimes resembling the calcified areas in renal tuberculosis. When they encroach

upon the pelvis or calyces they may give rise to a filling deformity in the pyelogram resembling a neoplasm. The masses of sandy material giving rise to bizarre shadows of irregular density were found secondary to chronic suppurative pyelonephritis. The third type is that due to calcareous deposits in organized blood clots resulting from hematuria which at times may be due to true calculi.

An unusual type of calculus is that caused by *Proteus ammoniae*. The roentgen shadows cast by these stones may not be as dense as the usual renal calculus and are characterized by unusually rapid growth. These findings should lead one to suspect this condition and the urine should be cultured for the presence of *Proteus ammoniae*.

Among the unusual calculi of interest are those found encysted in the renal cortex a short distance beyond a calyx. Many of these result from cicatricial changes occurring around them in a minor calyx so that eventually they become completely separated from the calyx. In other instances the cyst is primary and the stone forms subsequently. Such calculi are often mistaken for extrarenal shadows. A pyelogram may be of aid in revealing a small communication between the cyst and adjacent calyx. In such cases secondary inflammatory changes are usually found in the other calyces and the pelvis. Pyeloscopy may be necessary at times to reveal the exact location of the suspected shadow.

A brief reference is made to a type of lithiasis which occasionally is observed as a cause of hematuria. On surgical exploration, gross calculi are not found but microscopic examination will disclose the presence of numerous calculi in the renal tubules. Such minute calculi do not show on the roentgenogram.—*Karl Kornblum*.

MCCARTHY, JOSEPH F. A consideration of technique in the management of new growths of the bladder. *J. Urol.*, March, 1930, 23, 323-329.

Some dogmatic conclusions are given relative to the management of new growths of the bladder. Emphasis is laid upon the necessity of accurate diagnosis before any form of treatment is considered. By this is meant a thorough and painstaking study of the patient.

In the roentgen study, three factors should be considered: (1) the presence or absence of

metastasis; (2) any pronounced deviation from the normal in size, conformation or position of the kidneys, and (3) a stereoscopic roentgenogram of the bladder filled with 5 per cent solution of sodium iodide. Finally, where the absence of vesicorenal reflux has been demonstrated, another stereoscopic exposure with the air-filled bladder.

Rectal transillumination should supplement cystoscopy. Inspection of the deep urethra should be routinely done. A biopsy should be had in all cases.

The two methods advocated for the treatment of new growths of the bladder are diathermy and radical excision. Each has its specific indications. Total cystectomy should be done more frequently and earlier.

As to irradiation in this form of malignancy, the author states, "Our experience with radium and deep x-ray therapy, under the guidance of physicists familiar with these agents, has been distressingly disappointing. We no longer advocate their use."—*Karl Kornblum*.

DOSSOT, RAYMOND. Cancer of the prostate; its origin and extension. *J. Urol.*, Feb., 1930, 23, 217-245.

A translation from the French in which the author desires to emphasize two points in particular: (1) The relationship which exists between adenoma and cancer of the prostate; (2) the precocity of malignant degeneration.

In regard to the first point, exception is taken to the view held by a group of American authors, who believe that hypertrophy and cancer of the prostate are two conditions absolutely distinct. Reference is made to a series of 450 prostatic cancers reported by Geraghty in 1922 in which there was noted an association with hypertrophy in 75 per cent of the cases. In the series of cases which form the basis of this paper cancer and adenoma were associated in 58.7 per cent of the cases. The author is of the opinion that prostatic adenoma plays an important rôle in the pathogenesis of many cancers. In 11.6 per cent of cases adenomata undergo malignant transformation. Two types of prostatic cancer are distinguished: urethroprostatic adenoid cancer which develops from the adenomatous glands of the prostatic urethra, and true cancer of the prostate which develops from the prostate itself. The latter may coexist with an adenoma.

As regards the second point, the author does not believe that cancer remains limited to the prostate for any great length of time and that by the time it is possible to recognize cancer of the prostate clinically it usually has spread to other portions of the body. This malignant involvement may be to one of the adjacent organs such as the seminal vesicles, which are frequently involved, the bladder, urethra, corpora cavernosa and rectum. The cellular tissues of the pelvis are not infrequently involved. This may be quite extensive which seems particularly to be the result of an especially malignant type of cancer. The kidneys and ureters are secondarily involved as the result of pressure upon the lower ureters or ureterovesical orifice. Involvement of the lymphatic glands is of very great importance and constitutes the broadest obstacle to the radical treatment of carcinoma of the prostate. A review is given of the lymphatics of the prostate with the group of glands most commonly involved in malignant spread from the prostate.

Under the heading of metastases it is noted that visceral metastases are infrequent. Bone metastases, however, are common. Bumpus, who systematically examined his cases roentgenologically, found bone metastases in 30 per cent of the cases. Bone metastases occur especially in the vertebral column (lumbar portion) and bones of the pelvis, after which come the long bones (femur), the skull and the ribs. Such metastases are likely to be passed unnoticed if one does not search for them routinely.

As to therapy, the author regards all forms of treatment, surgery, radium therapy, combination of surgery and irradiation as "frankly mediocre," when directed toward clinically recognizable prostatic carcinoma because of the inability at this stage of the condition to completely eradicate all of the malignant process. The only cases in which the hope of a cure can be entertained are those patients operated upon with a diagnosis of adenoma in whom histological examination shows the existence of cancer. In frankly malignant cases the best one can do is to limit his efforts to palliative therapy; passage of sounds and cystostomy; radical treatment in any form, either by surgery or irradiation, is not advocated.—*Karl Kornblum*.

## NERVOUS SYSTEM

LÜDIN, MAX. Ueber Myelographie. (Myelography.) *Schweiz. med. Wchschr.*, Jan. 11, 1930, 60, 29-32.

The author presents in this article his experience with myelography and reports 7 cases in detail where the roentgen diagnosis could be checked by either operation or autopsy. He prefers the puncture of the cistern; the lumbar puncture with the injection of ascending lipiodol is, in his opinion, a dangerous procedure and merely interesting from a technical standpoint. The injuries observed in cases subjected to the latter method illustrate this very clearly. The determination of the upper tumor level usually suffices for the surgeon who can obtain a better idea of the extent of the lesion on operation. From the cisterna cerebello-medullaris 2 or 3 c.c. of liquor are removed followed by slow injection of 2 c.c. of warmed 40 per cent lipiodol Lafay with the patient in sitting position. Roentgenograms are taken immediately, 1 to 2 hours, 6 hours, 24 and 48 hours after the injection. During that time the patient must be kept in a sitting position.

Myelography should not be carried out sooner than six to eight days after a lumbar puncture. The typical oil stop which permits the roentgen diagnosis of a tumor may also occur in cases of pachymeningitis hypertrophica and in tuberculous spondylitis. The method may also fail; this is illustrated by 2 cases, one of a psammoma in the region of the 6th to 7th thoracic vertebrae where only a temporary oil stop with a few scattered oil drops were seen between the 5th and 8th thoracic vertebrae, and one of myelitis in the conus terminalis where the roentgenograms showed a permanent stop in the region of the 11th thoracic vertebra. The author did not observe any serious consequences following myelography in his limited number of cases. Slight disturbances as, for instance, rises in temperature, neuralgia located in the limbs, headache and backache are only temporary. Excellent roentgenograms and reproductions of the tumors found on operation or autopsy illustrate the article.—*E. A. Pohle.*

## SKELETAL SYSTEM

MILANI, EUGENIO. Esostosi osteogenetiche a tipo familiare, associate in un caso con alterazioni discondroplasiche bilaterali. (Osteo-

genetic exostosis of a familial type, associated in one case with bilateral dyschondroplasia.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 55-70.

A case is described in a young man, aged twenty, with no special family history. He developed normally but at the age of puberty there was a certain amount of malformation of the knee to which little attention was paid. But for some time he had had a certain amount of difficulty in walking from swelling of both knees. There was also enlargement of the upper end of the humerus. Roentgen examination showed the knees enlarged, particularly the metaphysis of the right femur; there was a large exostosis on the outside of the metaphysis; it was not very dense and had a large base on the condyle. There was a smaller exostosis on the inner condyle. The epiphysis did not seem to be greatly changed; the joint cartilage on the right was irregular in outline, the metaphysis of the lower end of the right femur was abnormally transparent with rarefied zones, particularly at the implantation of the exostoses. The lower end of the left femur was more regular but less developed. The metaphyses of both tibias were also enlarged. The joint cartilages were very irregular. There were exostoses on the inner sides of both metaphyses and the one on the right especially was abnormally transparent. The heads of both fibulas were swollen and rarefied without any spongy bone but almost homogeneous with oval zones that were more transparent than the rest of the bone. The humeri on both sides were deformed. The cortex was thickened and the marrow canal large. The metaphyses were enlarged with exostoses which formed crests. There was broadening and flattening of the distal end of the humerus with a large flat trochlea. There were exostoses on the lower borders of the ribs.

The sister of this patient, twenty-four years of age, had an exostosis on the outer surface of the upper third of the humerus.

The patient had a combination of dyschondroplasia and osteogenetic exostoses. At the end of two years of observation the exostoses of the knees and the two femurs showed irregular but progressive ossification.

In connection with the case the author discusses the points of difference between exostosis, chondromatosis and dyschondroplasia.—*Audrey G. Morgan.*



COPELAND, MURRAY M., and GESCHICKTER, CHARLES F. Ewing's sarcoma; small round cell sarcoma of bone. *Arch. Surg.*, Feb., 1930, 20, 246-304.

This group of 60 cases of Ewing's tumor is selected after a comparative study of all the cases of tumors of bone, both benign and malignant, in the Surgical Pathological Laboratory of the Johns Hopkins Hospital (representing in all over 1500 cases together with 1000 cases of diseases of bone). Among 300 sarcomas of bone, 15 per cent were Ewing's sarcoma. The majority (95 per cent) occurred in the first two decades of life. It is rare in all races except the Caucasian.

Trauma seemed definitely related to the subsequent onset of symptoms in all cases in which it was recorded. The average lapse of time between the trauma and the onset was five and a half months.

*Clinical Characteristics.* Pain was the outstanding symptom in 50 cases (83 per cent) and was the first symptom in 21 cases (35 per cent). The characteristic course of the pain is summed up as follows: Stage 1—Tenderness or soreness following trauma or arising spontaneously on motion. Stage 2—Intermittent pain of dull aching or sharp shooting character. Stage 3—Periods of freedom from pain. Stage 4—Continuous pain, dull or sharp, appearing with progression in size of the tumor or spontaneously, and subsiding after regression in size of the tumor or after operation or roentgen treatment.

*Tumor.* In 56 cases (90 per cent) a mass was palpable and in 19 per cent a swelling was the initial symptom. Tumor masses varied from small localized swellings to large fusiform masses extending along almost the length of the bone. Vasomotor changes were common with dilatation of surface vessels and in some cases elevation of temperature. The soft parts were usually freely movable. The tumors were totally immobile and apparently continuous with the bone. Variations in the size of the tumors and in the severity of the pain were noted, probably due to hemorrhage and absorption of hemorrhage. The long pipe bones were most frequently involved, the tibia most frequently (915 cases).

*Fracture.* Pathological fractures were noted in only 3 cases (all of the femur). This is a relatively infrequent complication as compared

with its occurrence in other bone tumors (multiple myelomas, 62 per cent; bone cysts, 45 per cent; giant cell tumors, 14 per cent, and general sarcoma of bone, 8 per cent).

*Constitutional Reaction.* Elevation of temperature was noted in 30 per cent of cases and of these more frequently in the later cases. The average was 100. Bence-Jones bodies were not found. The blood picture varied from normal to a mild secondary anemia. The white counts were from a mild leucopenia to a moderate leucocytosis. Nutritional disturbances were mild until the later stages. Local swelling about the tumor and distal to it was frequent.

*Roentgen Studies.* The changes are most often diffuse and situated near the mid shaft region of a long bone. Six early cases showed relatively little medullary involvement, slight expansion of the cortex with a periosteal reaction looking somewhat like onion peel. The cortex appeared thickened with some mottling in the region of the medullary cavity due to areas of increased density.

Twenty later cases showed a considerable part of the shaft involved as though the tumor extended more readily in a plane parallel to the axis of the bone. The medullary cavity often showed osteoporosis and the cortex evidence of destruction. Increased density of bone in the region of the widened cortex was the most characteristic finding. Osteophytes arranged irregularly or at right angles to the cortex appeared occasionally. The epiphyses were secondarily involved in 2 cases.

Both the formation of new bone and the destruction of bone are secondary to infiltration of bone by tumor. In the early stages formation of bone predominates, later destruction of bone is seen both in the cortex and medulla. These studies do not support the views that Ewing's tumor is primarily a destructive tumor or that it is of medullary origin.

*Gross Observations.* All specimens but one showed the bulk of the tumor lying subperiosteally. The medullary cavity was usually constricted or totally occluded by new reactive bone. The widened cortex was due to both subperiosteal and endosteal formation of new bone. Destruction of bone was not a prominent feature; when present it seemed to result from interruption of blood supply where the tumor had invaded and blocked the Volkmann and Haversian canals.

Parallel deposits of new bone occurred when the periosteum had suffered minute separation while spicules were laid down at right angles to the bone when increased separation occurred. These two types of formation of bone duplicate the process observed in the embryo. The soft part of the tumor was usually encapsulated with a thin layer of fibrous tissue which at its margins was continuous with the periosteum.

*Microscopic Observations.* In compact areas the cell is small and polyhedral with a round nucleus. The cytoplasm is scanty and practically stainless. In less compact areas the cytoplasm has a more definite outline and is faintly eosin stained. The nucleus is deeply stained and mitotic figures not infrequently noted. There appeared to be no intercellular stroma but a fine trabeculation divided the tumor into lobules. The vascularity was variable.

*Dissemination and Metastasis.* Metastasis has occurred in every case that has to date of writing terminated in death. The most frequent sites were the lungs, lymph glands and skull. The predilection of secondary growths for other bones is thought by some to be proof that the tumor is primarily a multiple disease. The authors do not agree with this. The most frequent bone metastases occur in the skull, spine, scapula and clavicle.

*Clinical Course.* The onset is with tenderness of the affected part followed by pain either dull or sharp, trauma followed by pain or pain with formation of a tumor. The pain is more or less continuous. Nocturnal pain may be the most severe. Regression of the tumor and diminution of pain are frequent. The temperature may be slightly elevated and there may be localized redness and swelling. To palpation the tumor mass is usually fusiform and continuous with the bone itself. The condition progresses, usually terminating with metastasis, the final symptoms varying with the site of metastasis.

*Differential Diagnosis.* Early diagnosis is both important and difficult. Inflammatory bone disease is the most frequent preliminary diagnosis. The microscopic changes as well as the symptoms and roentgen findings are similar. Syphilitic periostitis is especially confusing. If a positive Wassermann is found a therapeutic test may be of value. Multiple myeloma is differentiated by the multiplicity of lesions,

skeletal deformities, pathological fractures and the presence of Bence-Jones bodies. Osteogenic sarcoma is usually located nearer the ends of the long bones and while it shows radiating spicules, the laminated new bone paralleling the shaft is almost never seen. Irradiation of the tumor is a good therapeutic test, Ewing's tumor responding promptly whereas osteogenic sarcoma is little affected. Metastatic carcinoma occurs later in life and usually shows a single medullary lesion destroying bone at the site of the nutrient artery.

*Treatment and Prognosis.* In cases where metastases have not occurred amputation for lesions below the upper third of the femur and resection of bones for lesions of the upper extremity, followed by irradiation is the method of choice, as in all diffuse and periosteal malignant lesions of bone. If the lesion is too extensive, irradiation alone may be used until amputation is necessary to relieve pain. Never perform a biopsy and wait for a diagnosis. Frozen section and immediate operation are necessary.

Eight cases (18 per cent) of this series are well after five years from the onset of symptoms and 6 are living over five years after operation. Coley's toxins have no apparent effect. Exploration does not necessarily affect the prognosis in cases in which radical operation or roentgen treatment follows operation.

*The Nature of Ewing's Tumor.* The conclusion of the study is that the tumor is a malignant sarcoma of bone. In favor of this is the age incidence, its location, the cellular nature, the metastases and the high percentage of fatality. The failure to find a primary focus outside of bone is against the theory of its metastatic nature. The authors do not believe that it is a myeloma originating in the marrow cavity. On the contrary, the evidence points to an origin in either the intracortical or subperiosteal regions, perhaps in the Haversian systems. They also believe that this tumor is not primarily osteolytic.—*P. A. Bishop.*

COPELAND, MURRAY M., and GESCHICKTER CHARLES F. The nature of Ewing's tumor. *Arch. Surg.*, March, 1930, 20, 421-436.

A group of 60 cases of Ewing's tumor were selected from more than 400 cases of malignant tumors of bone. The prognosis and ultimate results were available in 52 of these cases by clinical follow ups. The majority (95 per cent)

of cases occurred in the first two decades of life. There was only one negro in this series. The long pipe bones were most frequently affected, principally those subjected to trauma. In all cases the primary growth was on the shaft side of the bone.

*Symptoms.* Trauma was recorded and seemed definitely related to the onset in 22 cases. Pain was outstanding in 83 per cent and was the first symptom in 35 per cent. A tumor could be palpated in 90 per cent and was the initial symptom in 19 per cent. The average duration of the tumor at the time of first observation was thirteen and a half months. The masses varied from small localized swellings to large fusiform masses. Surface discolorations were frequently noted. Pathological fractures are rare. Constitutional disturbances and blood changes are slight except late. Internal metastases are late.

As seen roentgenographically Ewing's sarcoma is most often diffuse and is situated near the mid shaft which is expanded by diffuse infiltration, with widening and increased density of the cortex and mottling of the marrow cavity due to areas of increased density. Both new bone formation and bone destruction are secondary to infiltration by the tumor. In early cases bone formation predominates, giving rise to parallel layers or radiating spicules of new reactive bone. In the later stages bone destruction, both medullary and cortical, characterizes the roentgen picture. The authors do not feel that the roentgen studies indicate that the tumor is primarily destructive or that it is of medullary origin.

The pathological changes confirm those of the roentgenogram. The tumor was found to be subperiosteal with one exception. The medullary cavity in some cases contained small portions of tumor, but was usually constricted or totally occluded by new reactive bone. New bone may undergo subsequent destruction when surrounded by the tumor, apparently because of interruption of blood supply when the tumor has blocked the Volkmann and Haversian canals. The parallel layers of new bone are formed when the periosteum has suffered minute separations, the radiating spicules when the separation is more marked.

Dissemination and metastasis occurred in every case that was fatal. The most frequent sites were in the lungs, the lymph glands and

skull. The most frequent incorrect diagnosis was "inflammatory bone disease." Of 52 cases, 43 are dead and 8 (13 per cent) living, with an average duration of life of seven years and eight months.

*Treatment.* Combined radical operation and roentgen therapy is the method of choice. Exploration does not seem to affect the prognosis when followed by this procedure.

In conclusion, the statement is made that they are unable to state either the site of origin or the histogenesis of this tumor but that they believe that the primary focus is specific for bone and is probably either intracortical or subperiosteal.—*P. A. Bishop.*

CONNELL, W. W. Thyroid metastases in bone. *Brit. J. Surg.*, Jan., 1930, 17, 523-528.

The author believes the subject of thyroid metastases in bone is an extremely controversial one, only to be approached with an open mind and in a spirit of inquiry. No convincing definition of malign, as opposed to innocent, tumors exists. In place of a definition one must be content with mere tabulated lists of characteristics supposed to be pathognomonic of the two classes of neoplasm. He reports 2 cases of supposed thyroid metastasis, only one of which came to operation and thus only one pathological examination was obtained. This case was an African woman who complained of a large and painful lump on the back of the head, of three years' duration. There was a fleshy mass about the size of an ostrich's egg projecting from the occipital region of the skull, no exact measurements being given by the author. It was fixed to the subjacent skull and had dilated veins in the overlying skin. A hard and slightly nodular mass could be palpated in the left lobe of the thyroid gland. A hard and fixed gland was palpable in the right subclavian triangle. The patient stated she had had a lump in her neck ever since childhood.

The roentgenogram showed that the outer table, diploë and a part of the inner table of the occipital region of the skull had been destroyed and replaced by the growth described; expansion had been chiefly at the expense of the outer table. The patient disappeared from the hospital and so could no longer be followed. The pathologist reported that the structure of the tumor resembled for the most part a fetal adenoma.

Thyroid osseous metastases, tumors containing thyroid tissue, have been reported previously, but the nature of these deposits has given rise to much speculation. Connell takes the view that all such cases are probably dependent on the presence of a thyroid carcinoma, which may be so atypical, so slow, and insidious, that its true nature is apt to be overlooked. It is incredible that a malignant thyroid can produce a benign metastasis. The suggestion that a benign thyroid may produce either a benign or a malignant metastasis is less unreasonable, and is certainly supported by a good deal of incomplete clinical and histological evidence. At present only a verdict of "not proven" can be returned. Where the risk is not excessive and the metastasis is apparently single, the treatment recommended is excision of the metastasis, followed by thyroidectomy. Prophylaxis depends upon the removal of all thyroid tumors as soon as recognized.—*R. S. Bromer.*

PHEMISTER, D. B. Chondrosarcoma of bone. *Surg., Gynec. & Obst.*, Jan., 1930, 50, 216-233.

A plea for the recognition of chondrosarcoma as a distinct clinical entity among the malignant tumors of bone. In the classification of the Registry of Bone Sarcoma of the American College of Surgeons this tumor is included under the heading of osteogenic sarcoma, a term broadly used to indicate all malignant tumors derived from bone or from tissue destined to form bone. It is admittedly hard to classify tumors containing cartilage, but since benign cartilaginous tumors or chondromata of bone are quite generally recognized, it would seem equally feasible to recognize a class of malignant cartilaginous tumors. Chondrosarcomata have long been recognized as a class in the European literature and are still so recognized by many American pathologists.

As a means of differentiation the author would designate sarcomata consisting largely of cartilage as chondrosarcomata and those containing tumor bone with cartilage either absent or present only in small amounts in the regions of ossification as osteogenic sarcomata. Chondrosarcomata present sufficiently distinct morphological, clinical and roentgenological characteristics to warrant their designation as a separate entity. Such tumors of the long bones may arise either centrally or peripherally. They are nearly always located in the ends of

the shaft beginning some distance away from the epiphyseal line.

Central chondrosarcomata erode the cancellous bone and cortex within, producing an expansible swelling of the shaft. In some cases, this is unaccompanied by new bone formation on the periosteal surface, while in others there is marked periosteal new bone formation leading to a thick shell about the central tumor. There may be a thickening of the cortex above and below the tumor for some distance. Such tumors cast a characteristic shadow in the roentgenogram.

Chondrosarcomata arising peripherally or breaking through the cortex early, with the development of a large peripheral lesion, are likely to possess islands and branching areas of calcification and ossification which produce a characteristic picture on the roentgenogram making it possible to diagnose the condition preoperatively. They may also invade the medullary cavity of the bone, but the characteristic bone proliferation with the formation of a shell, such as is seen in central chondrosarcomata, is absent.

These tumors may also occur in the short or flat bones of the trunk, usually beginning centrally and breaking through the cortex to form an external tumor mass without stimulating thick shell formation.

Some of the chondrosarcomata arise from enchondromata and cartilaginous exostoses. While such an occurrence is relatively rare, it is still more uncommon to find a malignant tumor developing from an exostosis in the condition known as multiple cartilaginous exostosis (hereditary deforming chondrodysplasia). However, a number of such cases have been reported, including one in the present paper.

Ten cases of chondrosarcoma studied pathologically in the laboratories of the surgical clinics of the University of Chicago form the basis of this paper. The histories, the pathological findings, both gross and microscopic, are given in considerable detail. The article is well illustrated with roentgenograms, prints of gross specimens and photomicrographs. Of the 10 cases reported, one is alive 10 years after excision, one 9 years after amputation and one  $3\frac{1}{2}$  years after amputation. This in conjunction with the history of long duration in another case would perhaps indicate a better prognosis than that for osteogenic sarcoma.—*Karl Kornblum.*



## GENERAL

CHIPMAN, ERNEST D., and TEMPLETON, H. J.  
Coccidioidal granuloma. *Arch. Dermat. & Syph.*, Feb., 1930, 21, 259-278.

A detailed report of 2 cases of coccidioides granuloma giving a description of the lesions grossly and microscopically, details as to cultural studies and the various laboratory examinations indicated in this disease. A discussion as to the treatment proposed by others and that used in the reported cases is given.

In most of the cases of granuloma coccidioides that have been reported the patients have lived in California. San Joaquin Valley has apparently contributed most of these cases. The disease is due to the *Coccidioides immitis*. It is likely to be confused with blastomycosis. It has been also mistaken for syphilis, epithelioma and tuberculosis. Especially is tuberculosis simulated in that in the generalized form of granuloma coccidioides the lymphatic glands and lungs are involved in much the same manner as in tuberculosis.

The disease may be localized or generalized. Few cases of the latter form ever recover. In addition to the lymphatic and pulmonary system, the bones are frequently involved in the generalized form of the disease. In one of the cases reported, discharging sinuses over both iliac bones led to a roentgen examination of the pelvis. A punched-out area was found immediately below the middle third of the iliac crest on the left side. Below this there was an area of sclerosis. On the right side there was a necrotic area near the anterior superior spine while to either side of this area the bone was hypertrophied and sclerosed.

In 23 cases of generalized coccidioidal granuloma reported by Hammarck and Lacey, 21 showed bone involvement. Roentgenologically there seems to be no way of differentiating the disease from tuberculosis of the bone. It has been suggested by Taylor that a proliferative process associated with a particularly fulminating bone destruction is more characteristic of coccidioides than tuberculosis.

At the close of the paper there is an abstract of the discussion by a number of prominent dermatologists. The discussion deals chiefly with methods of treatment.—Karl Karnblum.

MATUSOFF, IRVING. Congenital mirror picture dextrocardia with situs transversus,

patent ductus arteriosus and subacute bacterial inflammation. *Am. J. Dis. Child.*, Feb., 1930, 39, 349-353.

Matusoff reports an unusual case of congenital mirror picture dextrocardia, with situs transversus, congenital developmental defect of the heart, probably patent ductus arteriosus and subacute bacterial inflammation, giving no clinical manifestations of the involvement of any valve of the heart.

The diagnosis of patent ductus arteriosus was considered on the basis of the following points: (1) dullness in the upper spaces to the right of the sternum; (2) a thrill systolic in time, over this area; (3) a markedly accentuated pulmonic second sound; (4) the roentgen shadow over the pulmonic area due to increased volume of the pulmonary artery; (5) a systolic murmur of the humming type, transmitted upward and to the right.

The diagnosis of subacute bacterial inflammation was considered because of: (1) a septic fever unassociated with any known focus of infection; (2) an enlarged spleen; (3) emboli in the kidneys; (4) petechiae; (5) a positive blood culture of *Streptococcus viridans*.

It was believed that bacterial inflammation was limited to the patent ductus arteriosus because: (1) There were present all the basic signs and symptoms of subacute bacterial endocarditis, with no known focus of infection in any other part of the body and no clinical signs of endocardial involvement. (2) At no time, and in spite of numerous examinations, were there any murmurs heard near the apex or the aortic areas. (3) The clinical signs in this case are similar to three others cases in which autopsy was performed.

Matusoff summarizes the post-mortem observations in 19 cases of patent ductus arteriosus with infection, and also the frequency of subacute bacterial endocarditis in congenital heart disease.—R. S. Bromer.

BELLOT, J. Un cas difficile d'expertise médico-légale. Diagnostic rectifié par l'examen radiologique. (A difficult case of expert medico-legal testimony; diagnosis corrected as a result of roentgen examination.) *Bull. et mém. Soc. de radiol. méd. de France*, Feb., 1930, 18, 66-68.

The author describes an interesting medico-legal case in which the roentgen examination

revealed a collapse of the body of the 2d lumbar vertebra, with normal structure and density of the vertebral body and without narrowing of the intervertebral spaces.

The patient who was a chronic epileptic gave a history of trauma. During the army service he fell from the second storey and following this accident a gradual scoliosis of the lumbar portion of the spine developed. Later he was discharged from the army and was suing for compensation. The previous medical diagnosis was Pott's disease.

On the basis of the above roentgen findings the author changed the diagnosis to Kummell-Verneuil's disease. It is probable that the trauma led to a gradual decalcification of the vertebra involved, resulting in collapse of the vertebral body and subsequent scoliosis.—*T. Leucutia.*

SOILAND, ALBERT, and MELAND, ORVILLE N.

Radiation service in the modern hospital.

*J. Am. M. Ass.*, Jan. 25, 1930, 94, 239-241.

In a large and active hospital the diagnostic and therapeutic divisions of radiology should be under separate heads in order to obtain the greatest efficiency from both. The therapeutic department should have in all instances equipment which is adequate. Valve tube rectification presents some desirable features. Usually a superficial machine and a deep therapy machine are required. Radium must be employed properly or not at all, and in most instances it is preferable to substitute adequate deep roentgen therapy for inadequate radium treatment. Consequently, it is desirable to possess sufficient radium to make a pack when necessary.

There are many conditions other than malignancy in which irradiation is beneficial, and it is the duty of every radiologist to keep all the other members of the hospital staff informed concerning the value of radium and roentgen treatment in every type of disease.—*G. R. Miller.*

KNUTSSON, FOLKE. Über die Feuergefährlichkeit des Röntgenfilms. (Danger of fire from roentgen films.) *Acta radiol.*, 1929, 10, 566-587.

The author discusses the danger of fire from roentgen films kept in hospitals, using in illustration reports in the literature of a number of such fires and particularly the Cleveland disaster.

In that greatest of film fires half the people in the building lost their lives while in most of the earlier fires there does not seem to have been any loss of life. It is hard to explain the many deaths in this case by the poisonous gases formed by the explosion of the films and the author brings up the question of whether the large death toll in Cleveland was really due to simple film-gas poisoning or whether it might possibly have been due to some other sort of gas poisoning unconnected with the films; he suggests phosgene. He discusses the physico-chemical characters of roentgen films and describes a number of experiments made in setting fire to such films. He then discusses the best way of storing roentgen films from the point of view of safety against fire. He mentions as a model for such storage the large stock department of the Swedish Film Industry at Stockholm, which was built according to principles evolved through a series of preparatory fire tests made by the Government testing office. He advocates the construction by hospitals of fire-proof buildings for the storage of films large enough to give room also for the roentgen films for some years to come.—*Audrey G. Morgan.*

GLOCKER, R. Die Filmbrandgefahr und die Massnahmen zu ihrer Verhütung. (The danger of film fires and the measures of prevention.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Jan., 1930, 41, 53-56.

The author discusses the circumstances which led to the Cleveland disaster and arrives at the conclusion that the following three factors must be taken into consideration when devising protective means: (1) the prevention of the ignition of the films; (2) the prevention of the extension of the fire to the neighboring structures, and (3) the provision for carrying off the poisonous gases produced by the burning films.

The measures embodying the three above principles are described in detail.—*T. Leucutia.*

## ROENTGEN AND RADIUM THERAPY

GALEWSKY, E., and LINSE, KARL. Erfahrungen über Dosierung und Filterung von Röntgenstrahlen bei Hautkrankheiten. (Experiences with dose measurement and filtration of roentgen rays in skin diseases.) *Strahlentherapie*, 1930, 35, 561-566.

The authors express the opinion that the smallest doses of roentgen rays possible should be used in skin therapy. This is especially true in alopecia areata, alopecia praematura, psoriasis and eczema of the eyelids, eczema of the lip, psoriasis of the hairy scalp, eczema of the scrotum and anus, and diseases of the female genitalia.

By following the above method no roentgen injuries whatever were observed in a rather large number of cases treated.—*T. Leucutia*.

ZUPPA, A. Radioterapie e sclerodermia. (Roentgen therapy in sclerodermia.) *Arch. di radiol.*, Nov.-Dec., 1929, 5, 967-975.

The author describes 5 cases which he treated by giving an irradiation every week for seven or eight weeks with a spark gap of 35 cm., filter 0.5 mm. zinc and 2 mm. aluminum; 2 ma. and 1/3 of an erythema dose. He found that irradiation of the spinal column is to be preferred to that of the region of the thymus and thyroid or local irradiation of the lesions. Irradiation of the spinal column is always followed by marked improvement or cure of the sclerodermia. Sometimes the condition recurs, but not in less than a year. This treatment should always be tried as it not only cures the local lesions but greatly helps the depressed psychic condition of the patients.—*Audrey G. Morgan*.

BERING, FR. Ueber Röntgenoberflächentherapie. (On superficial roentgen therapy.) *Strahlen-therapie*, 1930, 35, 250-258.

The author discusses in general outlines the value of superficial roentgen therapy in eczema, neurodermatitis, eczemas of children, kraurosis vulvae, psoriasis, hyperidrosis, acne, lupus vulgaris, furunculosis, skin carcinomas and hypertrichosis.

In connection with this he cautions against the continuation of roentgen irradiation until an atrophy of the skin is produced. Apart from the fact that this can only rarely be obtained, it often results in serious late injuries to the patient.—*T. Leucutia*.

TRANIER. Traitement des néoplasmes cutanées en une seule séance avec des rayons moyennement pénétrants. (Treatment of cutaneous neoplasms in one single sitting with rays of medium penetration.) *Bull. et mém. Soc. de radiol. méd. de France*, Dec., 1929, 17, 313-315.

The following technique is advised for the treatment of cutaneous neoplasms: 32 cm. skin target distance, 200,000 volts, 4 ma., filter: the thickness of the inner coating (oil container) of the Gaiffe drum and 5 mm. Al, 3500 to 4500 R in one sitting (1000 R Solomon corresponding to 8 min. exposure), the surrounding tissues being well protected by lead. In case of large tumors the lesion is divided into several smaller fields. The procedure is considered superior to the fractional method.—*T. Leucutia*.

GARGIULO, MARIO. Iridociclite tuberculare trattata con raggi Röntgen. (Tuberculous iridocyclitis treated with roentgen rays.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 253-254.

The patient was a young man of eighteen with a family taint of tuberculosis. For about two months he had had photophobia and intense lacrimation of the left eye, with pericorneal injection; the pupil was myotic and did not dilate easily with atropin; there was slight turbidity of the lower quadrant of the cornea where there were fine precipitates on its posterior surface. In the sphincter zone of the iris there were a group of small grayish nodules and a larger one in the upper internal part of the ciliary zone. There were recent synechiae at the border of the pupil and a grayish exudate covered the anterior surface of the lens. Vision 1/10. Antisyphilitic treatment did no good nor did tuberculin treatment. The author gave roentgen treatment with a focus distance of 30 cm., 2 ma., filter 0.5 mm. zinc and 2 mm. aluminum for 20 min. each on Aug. 5, 6 and 7, making a little more than 50 per cent of a skin erythema dose. This technique was used in an effort to avoid the increased tension and hemorrhage of the iris reported in 1927 by Mylius, and the transitory hyperemia of the conjunctiva and iris reported by Scheerer in 1925. There was no sign of hyperemia or increase of intraocular tension during the treatment. The first beneficial effect was decrease of the photophobia and disappearance of the corneal turbidity, and a more prompt and efficient action of atropin. After about twenty days the nodules had disappeared and the iris was normal in appearance. False cataract remained from organization of the exudate on the anterior surface of the lens. Vision 2/10, which may improve still further with a small sphincteridectomy. Clinically the iritis is cured and much more rapidly and completely than with other

treatments. Vision is still defective because of the late beginning of the roentgen treatment and the fact that the iris remained for some time in myosis, thus facilitating deposition of exudate on the anterior surface of the lens.—*Audrey G. Morgan.*

BIRKETT, G. E. The radium problem. II. Radium treatment of buccal carcinoma. *Brit. J. Surg.*, Jan., 1930, 17, 498-517.

The factors to be considered in the treatment of any malignant disease are: the primary growth, the immediate lymphatic area of drainage and the more distant metastases, generally in the thorax or abdomen, either blood- or lymph-borne. Radium therapy, Birkett believes, cannot pretend at its present stage to deal with the last factor. The problem of treatment of buccal carcinoma in the lymphatic area of drainage is by no means settled.

Squamous-celled carcinoma appears to spread by embolism. There is no histological evidence of its spread by permeation. Therefore there is no justification for dealing with the primary growth and the gland-bearing areas as separate entities. Thus, Birkett feels that the primary growth should first be treated. Block dissection as recommended by some, interferes with the blood and lymph supply of the affected side and increases the danger of radium necrosis. Unilateral block dissection also diverts the lymphatic flow to the opposite side and the glands there which may not have been previously involved may become so. He recommends that diagnosis be made upon clinical evidence. Analysis of his cases shows that recurrences are frequent after operation. Biopsy is a bad procedure in the interest of the patient. Radium treatment is a conservative measure in the mouth, while surgery often involves a partial or complete glossectomy. He believes that radium can, in a large number of cases, cure the primary growth.

Histologically he divides the lesions of buccal carcinoma into three groups according to their histological characteristics and their anatomical positions. All types respond to radium, but the most brilliant results are obtained in advanced cases at the base of the tongue, a type which is extremely radiosensitive.

Surface applications were at first tried with comparatively intense sources for short periods of time. Then implantations of needles containing radium salts or emanations followed,

but the principle of filtration so as to use only gamma rays was not employed. Gradually the intensity of the implanted sources was cut down, and the time of exposure was correspondingly increased. This was the foundation for the modern method of treatment of the primary growth in buccal carcinoma. Regaud combined this principle with the filtration advanced by Dominici. An analysis of about 50 cases which were apparently cured for varying periods, from one to nine years, showed that the principle of prolonged irradiation was responsible for 80 per cent of these apparent cures.

Needles are used in the Manchester and District Radium Institute in preference to removable platinum radon seeds. The seeds have a relatively short active length, needles can be more adequately spaced and will give greater depth of radiation. The success of both of course, depends upon the skill of the operator. Failure to implant accurately means that some part of the tumor is under-irradiated, leading inevitably to recurrence. A minimum filtration of 0.5 mm. of platinum is used. The dosage depends upon the linear intensity or the quantity of radium element or emanation contained per linear centimeter, the screen or the filter, the time of exposure, the number of sources used, and their active length, the position of the sources and their distance apart. Active length of an implanted source of radium refers to that part of the needle which contains radium salt or its emanation. The technique according to the above considerations is as follows: linear intensity, 0.66 mg. radium element, 1.7 to 2 mc. of emanation; screen, 0.5 to 0.6 mm. of platinum; time of exposure, 7 to 12 days; active length, 10 mm. to 30 mm., but the commonest is 15 mm.; number of sources, rarely exceeds 20, distance apart, 1 to 2 cm.

A general anæsthetic is given whenever possible, and the preference is for the intratracheal method. Palpation of the growth is essential, and the treatment of growths at the base of the tongue is considerably helped by forcible traction and bimanual palpation. This cannot be adequately performed under local anesthesia. Most authors stress the removal of teeth, but Birkett thinks that it is a definitely bad procedure where the growth lies near, or is in contact with the alveolar margin. A rapid spread often occurs along the alveolar margin as a



result of extraction of the teeth. In cases where a sharp and carious tooth has been the main factor in the production of a carcinoma of the middle third of the tongue the extraction of this tooth is beneficial, but Birkett believes that it is advisable to proceed with treatment rather than to cause delay by a widespread removal of teeth.

It is extremely important that needles be securely sutured, as otherwise—except where the base of the tongue is concerned—they will scarcely be retained for the full period of time. He describes in detail his method of fastening the needles. He has not come to any definite determination whether the use of radium or emanation is the more desirable. He has a distinct impression that those cases of buccal carcinoma which have developed necrosis have occurred where radium element has been used.

A full and detailed description for the insertion of needles in the various regions of the mouth is given. He does not think it necessary to wear lead plates over the alveoli or the hard palate as advocated by some to protect the bone and the adjacent soft tissues. It is better to remove the needles in some cases after five days and reinsert for a similar period under a general anesthetic. Errors of distribution made at the first insertion can be corrected.

With a perfect response to irradiation, in six or eight weeks' time little or no trace will be found of the original lesion. Mobility will at the same time have returned to normal. Under-treatment is characterized by the feature of persistent induration, although ulceration may have disappeared. Over-treatment leads to radium necrosis and if the reaction is marked the patient may succumb from pain, sloughing, exhaustion, inability to sleep, or to take food. Necrosis of bone is sometimes met with, but on the whole is not very frequent. Bronchopneumonia has occurred in 2 or 3 patients out of a total of 400. Hemorrhage was noted in only one case, and probably was the result of ulceration through the wall of the lingual artery and was easily controlled. In over-treated cases where a thick scar results, ulceration may occur in the center a year or more after the treatment. If a high standard is observed in the assessment of a primary cure, local late recurrence is extremely rare.

The technique for treatment of the lymphatic area is described. There are 3 main types of cases: (1) those in which there are no pal-

pable glands; (2) those in which there are palpable glands, either uni- or bilateral, and sufficiently mobile for radical surgical removal; (3) those in which there is unilateral and bilateral glandular involvement too fixed for surgical removal.

*Results of Treatment.* No five year figures are available. Functional results are almost perfect, especially in the tongue. Mobility is scarcely impaired, and only slight defects are noted when the tongue is protruded fully. As a palliative measure for the primary growth radium has fully justified itself as a therapeutic measure. The percentage of cure for the 1926 cases is 22.50; for the 1927 cases, 34.7; for the 1928 cases, 45.13.—R. S. Bromer.

SCHURCH, O. Ueber Voraussetzungen einer erfolgreichen Therapie beim Mundhohlenkarzinom. (What is essential for a successful therapy of carcinoma in the oral cavity.) *Schweiz. med. Wchnschr.*, Feb. 1, 1930, 60, 96-101.

The author has collected and analyzed 202 cases of carcinoma in the oral cavity which were observed and treated in several hospitals in eastern Switzerland from 1919 to 1928. One hundred and forty-eight cases had carcinoma of the tongue and floor of the mouth, 5 cases had an involvement of the lower jaw, 7 cases had carcinoma of the buccal mucosa. In 20 cases the palate was involved and 22 cases had carcinoma of the tonsils. In 123 patients the histological diagnosis of cancer could be made. In 71.2 per cent there were definite metastases while in 17.89 per cent the glands were not larger than a hazelnut and in 11 per cent no metastases could be found. Ten of the 202 cases were women; the average age was 55½ years. Syphilis was proved in only 5 cases, leucoplakia in 8 cases, excessive smoking in 54 cases. In 17 cases there was carcinoma in the family history. The average time between the appearance of the first symptoms and the beginning of the hospital treatment amounted to about four months; the interval between the appearance of the first symptoms and the first consultation with a physician to about two months. An incorrect diagnosis was made in at least 27.2 per cent of the patients; 69 per cent died either in the hospital, having a recurrence while there or had a recurrence shortly after leaving the hospital. In 5 cases there developed an esophageal carcinoma in addi-

tion to the oral cancer. The treatment consisted in the majority of cases of operation; some tumors were coagulated and very few were treated by roentgen rays or radium. The author concludes that under the present conditions in his district the percentage of temporary cure cannot exceed 18 per cent in all cases of carcinoma of the oral cavity. The most important factor in improving these results is early diagnosis and early treatment.—*E. A. Pohle.*

COLA. La Rontgenterapia dell'asma bronchiale. (The roentgen therapy of bronchial asthma.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 283.

There is a great deal of literature on the roentgen treatment of bronchial asthma and all authors are agreed that it is very effective and absolutely harmless. But they are not so well agreed as to the best method to be pursued. After testing a number of the methods the author comes to the conclusion that the best results are obtained by irradiating the hypophysis or thorax, or preferably associating the two. Absolute cure is only brought about in a certain percentage of the cases, mostly in young subjects and uncomplicated forms of the disease. In the majority of cases there are longer or shorter remissions in the attacks and a great decrease in their intensity. The treatment does not lose its effectiveness on repetition.—*Audrey G. Morgan.*

NICOTRA, A. Casi di fibro-angiomi del cavo nasale curati con la Roentgenterapia. (Cases of fibroangioma of the nasal cavity treated with roentgen therapy.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 255-261.

The author has treated 4 cases of fibroangioma of the nasal cavity successfully with roentgen rays. Only 2 of them are described as they are the only ones of which he had roentgen pictures. He used rays filtered through 0.5 mm. zinc and 3 mm. aluminum, with fields of various size depending on the region; focus skin distance 25 cm. Depth dose about 100 per cent divided and given through various fields. The next treatment was given after twenty days and after that still other periodical treatments with depth dose of about 70 per cent. After the second or third treatment there was a little hemorrhage which in the first case was serious enough so that the treatment was

stopped for a few days. The first treatment was divided into brief periods of about ten minutes each so as to avoid too great congestion of the angiomatous tumor resulting in hemorrhage. This technique is also designed to cause thrombosis of the most peripheral veins which also decreases the danger of the hemorrhage which the later and stronger doses might cause. The tumors began to decrease in size after the first treatment and there were no disturbances of any sort except the hemorrhage already noted. The tumors finally disappeared entirely leaving the nasal cavity unobstructed, and the patients' general condition improved. So far there has been no recurrence. In the first case described, operation was performed two years ago. In the second, it was performed only three months ago and there were signs of malignancy so it is possible that there may be recurrence in that case. The author thinks roentgen therapy is to be preferred to surgery or radium therapy in these cases as it causes less hemorrhage and there seems to be less chance of recurrence if roentgen examination is made before treatment to determine the exact extent of the tumor.—*Audrey G. Morgan.*

SMITH, GEORGE G., and PEIRSON, EDWARD L. The value of high voltage x-ray therapy in carcinoma of the prostate. *J. Urol.*, March, 1930, 23, 331-342.

An analysis is given of 25 cases of prostatic cancer treated with high voltage roentgen therapy. In 15 of the cases some operation had been performed.

The physical factors employed in irradiation were a wave length of about 0.15 Å, 50 cm. distance, filtered through 0.5 mm. copper. A "series" usually consisted of at least an erythema dose over each of two portals, one anterior and one posterior. Sometimes the treatment was directed against the perineum.

The most outstanding effect from irradiation was in the relief of pain. Of the 18 patients having pain, all were relieved. This relief continued for from one to six months.

In some cases the malignancy of the growth appeared to be reduced, as evidenced by improvement in the patient's general condition and in the slowing up of the progress of the growth.

Urinary symptoms must be treated by appropriate measures as they are not improved by roentgen irradiation. The pain due to obstruc-

tion and to cystitis, unlike the other types of pain associated with this form of malignancy, is not affected by irradiation.

No cases are cured by roentgen irradiation but if metastases are not too widespread and the patient's general condition is not too poor, roentgen treatment is of benefit in the large majority of cases. It is stated, however, that the value of high voltage roentgen treatment of cancer of the prostate has not yet been firmly established.—*Karl Kornblum*.

WERNER, R. Der gegenwärtige Stand der Röntgenbehandlung des Krebses. (The present status of roentgen therapy of cancer.) *Klin. Wchnschr.*, Feb. 8, 1930, 9, 264-269.

This is a practical article dealing in the first part with the fundamental principles and in the second part with the practical application of roentgen therapy. The value of the method is discussed in tumors of the brain, of the pituitary gland and of the maxilla, in cancers of the mouth, tonsil and hypopharynx, in struma maligna, in mediastinal tumors, carcinoma of the breast (pre- and postoperative value), carcinoma of the esophagus, intra-abdominal and gastrointestinal tumors, carcinomas of the genitourinary tract, as well as in seminomas, sarcomas, and skin cancers. In many instances roentgen therapy must combine with local application of radium. Generally, one may say that the field of radioactive substances is gradually becoming broader while that of roentgen rays is being found limited. A further development of apparatus might reverse this relation.—*T. Leucutia*.

KRAUSE, PAUL. Ein Beitrag zur Kenntnis des Röntgencarcinoms als Berufskrankheit. (A contribution to the knowledge of roentgen carcinoma as an occupational disease.) *Strahlentherapie*, 1930, 35, 210-219.

In 1911 the author collected all roentgen carcinomas recorded in the literature and found that there were 94 cases, 24 of which were lupus roentgen carcinoma. In 1928, 126 cases were added, 9 of which were occupational roentgen carcinoma.

In the present article the author describes in detail a case of a roentgen carcinoma which occurred in a man fifty years of age who for a period of twenty-five years had worked with roentgen rays. In 1902 the patient suffered a roentgen burn which resulted in a severe roent-

gen dermatitis. This took a long time to heal and later small wart-like new-growths and areas of keratoses developed on the base of the roentgen burn. Since 1922 the patient had numerous operations and the microscopic examinations revealed the presence of carcinoma. For the last few years the extension of the carcinoma was rather rapid and in November, 1928, the patient died. At post mortem there was evidence of rather extensive metastases.

In connection with this the author discusses the several phases of occupational roentgen cancer such as the incubation time, surgical treatment by repeated amputations, inadvisability of the application of irradiations and the importance of protective means. Roentgen carcinoma as an occupational disease must disappear.—*T. Leucutia*.

LOCKHART-MUMMERY, J. P. The use of radium in the treatment of rectal carcinoma. *Brit. M. J.*, Jan. 25, 1930, 1, 139-140.

Radium in the treatment of rectal malignancy is still in the experimental stage. No definite conclusions concerning it can yet be drawn but it is at this time that the exchange of views and experiences is important. Radium may be used: (1) as an adjunct to excision; (2) as a treatment for inoperable cases; (3) as a substitute for operation.

The only justifiable treatment for rectal carcinoma is complete removal of the rectum and surrounding tissues. Radium needles may be implanted to decrease the extent of tissue to be excised. Several cases have been treated by local removal plus radium implantation. Colostomy was not desired by these patients. The results may prove sufficiently successful to warrant further trials.

The dosage of radium in inoperable cases and the technique of its application are still unsettled questions. The most satisfactory results have been obtained with 2 or 3 mg. needles screened with 1 mm. of platinum and rubber. The needles are placed 1 cm. apart, exposing the growth to uniform irradiation. A total dose of about 6000 mg.-hr. (size of growth not stated) is given and the needles withdrawn.

Radium is not a substitute for surgery in operable cases of rectal carcinoma. Its best results are in anal epitheliomata.

Inaccessibility, infection and susceptibility of normal rectal tissue make radium applica-

tion difficult in rectal carcinoma, and fibrosis from the first effect makes subsequent implantation very difficult. Improvements in technique seem to lie in the direction of: (1) increased screening; (2) radon seeds; (3) better asepsis in wounds of access.—*G. R. Miller.*

BORAK, J. L'importanza dell'actinoterapia nel trattamento del morbo di Basedow. (The importance of radiotherapy in the treatment of Basedow's disease.) *Arch. di radiol.*, Nov.-Dec., 1929, 5, 976-987.

Both surgery and radiotherapy act directly on the secretion of the thyroid, the former by decreasing the secreting surface, the latter by decreasing the secretion itself. Both may cause an increase of the signs of hyperthyroidism as an immediate result. Surgical treatment may eventually become necessary in any case, so while surgery may be said to stand at the head of methods of treatment for Basedow's disease, radiotherapy certainly stands at the head of conservative methods of treatment. And there are many cases in which surgery is impossible or inadvisable for one reason or another in which radiotherapy is absolutely indicated. Any internal treatment of Basedow's disease not associated with radiotherapy may be considered an incomplete treatment. The radiotherapy should be given in such a way as not to interfere with the performance of surgical operation which may later become necessary. Roentgen and internal treatment should be tried first and if they fail surgery must be resorted to.—*Audrey G. Morgan.*

FLORIN, MARIE. La Curietherapie dans le traitement des metropathies hemorragiques de la menopause. (Curie therapy in the treatment of hemorrhagic metropathy of the menopause.) *Schweiz. med. Wchnschr.*, Jan. 11, 1930, 60, 34-38.

The treatment of the menorrhagic metropathy during the climacteric by intrauterine radium application is recommended in this article. A single dose of approximately 2000 to 2500 mc-hr. filtered through 1.0 to 1.5 mm. of brass plus 0.1 to 0.75 mm. of aluminum, suffices in the average case to bring about permanent amenorrhea. A diagnostic curettage should always precede the radium insertion in order to rule out a malignancy. The technique of the intrauterine application is related in detail; if carried out properly it is, in the opinion

of the author, without danger. The percentage of cures can be as high as 95 per cent; the only contraindication recognized is a thickening of the adnexa. In such a case irradiation might stir up an old inflammatory process.—*E. A. Pohle.*

NICOTRA, A. Recerche istologiche sulla mucosa uterina dopo la castrazione radiologica. (Histological study of the uterine mucous membrane after roentgen castration.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 268-282.

After roentgen castration the patient has two or three menstrual periods which are apparently just like normal periods. This is in contradiction with the usual theory that menstruation depends on the corpus luteum, for these are menstrual periods without a corpus luteum. In endeavoring to explain them the author gives a detailed description of the uterine mucous membrane after irradiation and discusses the various theories of the cause of menstruation. The fact that the number of menstruations after roentgen castration coincides with the number of ovules liberated at each period suggested to him that the stimulus to menstruation may be furnished by the ovules themselves. In the normal sexual cycle the maturation of new follicles due to the cessation of function of the corpus luteum is the cause of the death of the one, two or three ovules which have been liberated during the last period. Irradiation of both ovaries with a castration dose destroys all the mature and maturing follicles. So the cause which generally produces the death of the one, two or three liberated ovules is abolished and these ovules therefore bring about the corresponding number of menstrual periods. To prove this hypothesis will require a more complete and detailed study of the normal sexual cycle in woman.—*Audrey G. Morgan.*

THIBAUDEAU, A. A., and BURKE, E. M. Carcinoma of the cervix uteri; an investigation of the relation between the histological findings and the results of radiation therapy. *J. Cancer Research*, Oct., 1929, 13, 260-267.

Attempts to determine prognosis upon the basis of the histological structure of neoplasms have been numerous of recent years. In this presentation the authors have compared 28 cases of carcinoma of the cervix uteri, having a five year cure, with a similar number of fatal



the basis of the histological classification suggested by Broders and the malignancy after the method of Hueper.

Cured cases had been treated by radium. The cases were divided into five clinical groups as follows:—

Group 1. Cases in which the malignancy was confined to the cervix.

Group 2. Cases in which the tumor had spread to the adjacent vaginal wall.

Group 3. Cases in which there was beginning thickening of one or both broad ligaments but with the uterus still movable.

Group 4. Cases in which the uterus was fixed.

Group 5. Cases in which there was recurrence after removal of the uterus.

For the purpose of comparison the same number of cured and uncured cases were taken in each group. The results in each group are tabulated.

In the histological classification of Broders there are three groups,—group 1 is the least malignant, group 3, the most malignant. In the malignancy index of Hueper, the higher the index the greater the degree of malignancy. From the tables presented it is seen that there were many tumors with either a high malignancy index or a high histological grouping or both, among the cases in all the clinical groups which recovered, while some of the fatal cases in the same clinical groups showed a low histological grouping and a low malignancy index. From this it is concluded that histological grouping and malignancy indices are of limited value in prognosis in cases of epithelioma of the cervix uteri and it would seem that factors, other than those thus far investigated, must be at least as important in the determination of the degree of malignancy in any given case.—*Karl Kornblum*.

WASHBURN, ALFRED H. Chloroma; report of a case with recovery following roentgenotherapy, with a review of the literature. *Am. J. Dis. Child.*, Feb., 1930, 39, 330-348.

Aside from the statistical value of reporting a case of chloroma which is relatively rare, Washburn believes he has ample justification for reporting his case because of the apparently complete recovery following roentgen therapy. Two and one-half years have elapsed so uneventfully since the treatment was instituted that a preliminary report seems worth while,

to be followed by a final report should the patient suffer a recurrence of the disease at some future date.

His review of the literature through June, 1929, shows at least 162 cases of chloroma reported since 1823. Although the majority of recent cases have been myelogenous and there is much in favor of the classification of chloroma as a form of myelogenous leucemia, it does not seem possible to deny the probable existence of lymphatic chloroma. His case was a boy, aged twenty months. Roentgenograms of the skull showed erosion of the outer plate by a tumor mass. Those of the lungs revealed a large mediastinal mass, interpreted as a lymph node metastasis. Those of the long bones brought to light a destructive lesion of the right femur, apparently a metastatic tumor growth. There was also a small area of decreased density in the lower end of the right tibia. The tumor mass in the head was operated upon and the conclusion, from the examination of microscopic sections of the excised tumor, was an apparent myelogenous tumor. The additional evidence gained from the gross appearance of the tumor and the examination of the smears from the fresh tissue seemed to justify the diagnosis of chloroma.

From Dec. 6, 1926, to May 9, 1927, the patient received seven treatments, each treatment consisting of two or three areas of exposure. All of the treatments except one represented 50 per cent of the skin tolerance dose. In view of the patient's poor condition and the widespread character of the tumor process it seemed wiser to give a relatively longer course of small doses rather than a shorter course of full erythema doses. In May, 1927, the roentgenograms showed no more evidence of bone destruction. The patient's condition was checked in May, July, and September, 1927. During this period the healing process in his bones which had begun under roentgen therapy had continued, and there was no evidence of any recurrence of the disease. The only abnormalities in his blood were a mild leucopenia and a few myelocytes. Ten months after the last treatment his health was still excellent and roentgenograms at this time showed practically complete healing of all the bone lesions. Clinically there was no evidence of the disease. In December, 1928, seventeen months later, there was no sign of recurrent disease. In May, 1929, there again was no recurrence and

his blood was within normal limits. The roentgenograms showed complete healing with no evidence of any new lesions.

The pathologic study of the biopsy specimens definitely ruled out both neurocytoma and endothelioma. The age of the child, the location of the tumors, the green color of the fresh specimen and the number of myelocytes in the blood stream all seemed to clinch the diagnosis of chloroma, so far as it was possible to do so without an autopsy. Roentgen therapy was tried merely as a last resort because of the natural desire to do something for the patient, not with any faith in its curative power. Because the author had found no other record of the use of the roentgen ray, he has given in his report a full list of the exposures in tabular form. He feels that one cannot escape the conclusion that the patient's recovery was directly dependent on the treatment given.—*R. S. Bromer.*

EPIFANIO, G. Irradiazioni Rontgen del plesso solare. (Roentgen irradiation of the solar plexus.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 286.

The author used irradiation of the solar plexus in celiac neuroses, gastric neuroses, gastric ulcer and diabetes insipidus. Among the celiac neuroses, the neuroses of the vagal type, such as those which accompany hyperchlorhydria and pylorospasm were particularly favorably affected. The author had good results in mixed forms and forms brought about by hypertrophy of the preaortic and mesenteric glands. He had similar results in gastric neuroses, which may be considered partial syndromes of celiac neuroses. The effects were good in nervous, motor and secretory neuroses.

In stomach ulcer roentgen irradiation of the solar plexus regulates neurotrophism and gastric secretion. In diabetes insipidus the decrease of the polydipsia and polyuria. decrease of polyuria seemed to be brought about by decrease of the feeling of thirst. Irradiation of the celiac plexus in diabetes insipidus should be associated with irradiation of the hypophysis and mesencephalon.—*Audrey G. Morgan.*

COLA. Crisi di epatargia durante il trattamento Rontgen del morbo di Banti. (Attacks of hepatargia during roentgen treatment of Banti's disease.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 285.

In one case of treatment of Banti's disease with roentgen rays the author saw a sudden increase in the signs of latent insufficiency of the liver and in another case a severe and fatal attack of hepatargia. As these serious results followed moderate irradiation in both cases, which however had acted on the left lobe of the liver as well as the spleen, the author thinks they must have been due to the action of the rays on the liver. Though normally the liver is very resistant to roentgen rays it is very sensitive to them in some degenerative and inflammatory conditions and he thinks that in these two cases of Banti's disease the irradiation of the liver aggravated a latent condition of insufficiency of the organ. He thinks that irradiation of the liver should not be practiced in diseases in which there is hypofunction of the liver, and in Banti's disease, in which liver insufficiency is always imminent, care should be taken to irradiate only the spleen and roentgen treatment should not be used in very severe cases.—*Audrey G. Morgan.*



# THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. XXIV

NOVEMBER, 1930

No. 5

## CAMPIODOL (IODIZED RAPESEED OIL)

### ITS USE IN THE ROENTGENOGRAPHIC VISUALIZATION OF THE BODY CAVITIES\*

#### *A Clinical and Experimental Study*

By MARK ALBERT GLASER,

LOS ANGELES, CALIFORNIA

IN order to more accurately visualize the cerebrospinal system, Frazier and Glaser, with the aid of Dr. George Raiziss, investigated radiopaque substances experimentally, with the resulting synthesis of campiodol, iodized rapeseed oil. It soon became apparent that no fully saturated iodized oil would give maximum visualization in all the body cavities because of non-miscibility, great viscosity and extreme opacity. For this reason special products of campiodol were synthesized for the various body cavities. This resulted in a greater accuracy of diagnosis, a perfection which heretofore had never been reached by any other iodized oil. In this paper, the use of campiodol and its modification products in the various body cavities will be considered.

#### HISTORY

The history of opaque substances began with the work of Tuffier (1896) who first used an opaque ureteral catheter. In 1901 Schmidt and Kolisher again, independently, described a similar catheter. Weil and Kienböck (1902) used freshly precipitated lead sulphate to outline the maxillary sinuses. They called attention to a thickening of the mucous membrane and concluded

that variations in this thickening was indicative of the course of the disease. Because of the toxicity of lead sulphate and the fact that it had to be washed out of the antrum, this method did not gain great prominence. In the succeeding years, Klose introduced the barium and bismuth meal for outlining the alimentary tract; Voelcker and von Lichtenberg (1906) utilized collargol, a colloidal silver compound, for the first successful mapping of the urinary tract; Boeck (1908) introduced bismuth paste for the visualization of fistulae; and finally, in 1915, Burns introduced thorium nitrate, an electrolyte, for pyelography. Due to the toxicity of thorium nitrate it was discarded, and it was not until 1919 with the introduction of sodium iodide by Cameron and Wells that pyelography became a universal procedure. In 1918 Chevalier Jackson was the first to outline the tracheobronchial tree by the insufflation of bismuth subcarbonate by means of a bronchoscope. During the same year, Stewart and Lynah suggested emulsions of bismuth with olive oil for a similar purpose. In 1921 Sicard and Forestier introduced lipiodol. This was followed by a period of more accurate visualization of many of the body cavities which hereto-

\* Read in part before the Southern California Medical Association, Los Angeles, Calif., Nov. 9, 1928.

fore could not be clearly outlined. In 1924, the outstanding contribution of Graham and his coworkers, the introduction of tetraiodophenolphthalein for gall-bladder visualization, opened a new means of roentgenographic exploration, that is, by means of the specific selectivity of the organs of the body for a chemical substance. In 1929, Binz, R  th, Swick and von Lichtenberg introduced uroselectan for intravenous urography.

#### EXPERIMENTAL STUDIES

In the search of the most ideal roentgenographic opaque substance for cerebrospinal visualization, attention was first directed to the discovery of the most satisfactory element. In the selection of elements the choice depends upon its ability to cast a shadow upon a roentgen plate, its ability to combine readily with other substances, the solubility and toxicity. After a trial of some thirteen elements, among which were barium, bismuth, bromine, silicon, tungsten, strontium, lead, iron, copper, silver, gold, platinum and iodine, it was found that iodine was the most satisfactory.

In an effort to determine the best inorganic or organic compound numerous products were synthesized, such as iodides, iodates, periodates, iodophenolphthaleins, iodized fluoresceins and iodized oleic, benzoic, quinoline and thymol compounds. None of these were satisfactory because of their toxicity produced upon subarachnoid injection in dogs. For this reason attention was diverted to iodized oils.

The ability of certain oils to combine with iodine depends upon the presence in them of unsaturated fatty acids. In such unsaturated oils iodine is held in firm union. Deterioration of the final product depends upon the method of chemical preparation. If there is an excess of free iodine in the final product, increased toxicity occurs. Dark products resulting from the splitting off of iodine are considerably more toxic than the light transparent ones. Oils of low specific gravity, high iodine

value, and low viscosity were selected. First, fish oils were utilized, and cod liver oil, meeting the above prerequisites, was deemed particularly adaptable because of its rapid absorption by the human body. This was converted into an iodo compound containing 55 per cent iodine. This product, however, gradually became dark, cloudy and ultimately turned black; menhaden oil acted similarly; sweet almond oil proved unstable. All these oils, upon subarachnoid injection, proved extremely irritating (Fig. 1). With rapeseed oil a

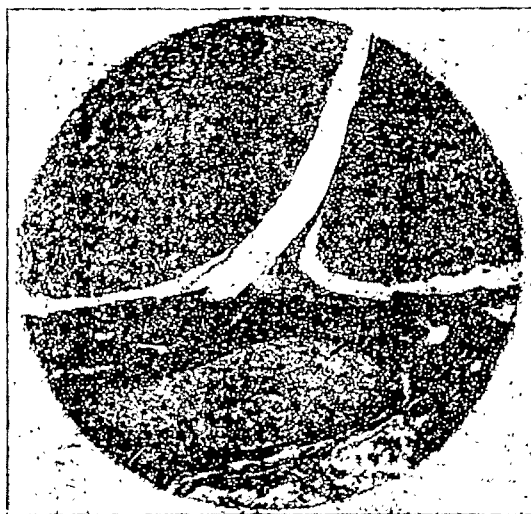


FIG. 1. Sweet almond oil injected into the subarachnoid space of a dog (No. 283), with death ten days postoperative. In this section there is a subarachnoid accumulation of polymorphonuclear cells. Meningitis is very evident. Congested vessels are visible. There is no invasion of cord substance. (57X.) (N. H. Winkelman.)

product was finally obtained which proved well suited in all details for our work.

Rapeseed oil, also known as colza oil, is a vegetable oil, of brownish yellow color, and is obtained from *Brassica napus*, *Brassica campestris* and *Brassica rapa*, all belonging to the family Cruciferae. To this same family belong white and black mustard. Rapeseed oil is composed of the glycerides of stearic, erucic and oleic acids. It is employed as an edible oil and for various industrial purposes. Its specific gravity is about 0.914. The saponifica-



tion value ranges from 167 to 178, and the iodine value from 93.5 to 105.6; its viscosity is 250 at 100° F. Upon iodization a light yellowish product (campiocol) is obtained, with a specific gravity of 1.289. This product deteriorates very slowly when exposed to light or heat, and upon roentgenographic exposure an intense shadow is obtained, so much so that dilution products may readily be made without destroying its clinical value.

Campiocol is only slightly irritating and is of low toxicity. Dogs have withstood an oral dose of 6.75 c.c. per kilogram of body weight. On injection of 1.5 c.c. per kilogram of body weight into the internal carotid artery with the external carotid ligated, no toxic effects were noted. In dogs weighing 4 to 6 kilograms 4 to 6 c.c. have been injected by cisternal punctures into the subarachnoid space without toxic effects. Spinal fluid cell counts on dogs in which 2 c.c. of the iodized oil had been injected into the spinal subarachnoid space varied from 250 to 800 cells per cubic millimeter. At the end of five or six days, the cell count ranged between 5 and 15 cells per cubic millimeter. No clinical effects were noted. In clinical cases of hydrocephalus, 7 c.c. of the oil was injected into the ventricles with a maximum count of 310 cells per cubic millimeter on the second day. In another clinical case 3.5 c.c. was injected into the ventricles with a maximum count of 19 cells per cubic millimeter three days after injection. Emulsified campiocol has been used without toxic effects in 250 pyelograms. As high as 125 c.c. of the emulsified product was utilized in a patient with hydro-ureter and hydronephrosis. Fifty per cent campiocol has been used in 40 cases of chronic maxillary sinusitis without any toxic effect. Straight campiocol has been used in 200 injections of the tracheobronchial tree without toxic effects. From these figures we may conclude that campiocol has extremely slight irritating qualities and though it produced some cellular reaction, this was of a very low degree.

To demonstrate spinal block for ventricular visualization, to outline sinuses and to outline blood vessels, lacrymal ducts, mastoids, eustachian tubes, fistulae, and in experimental work, particularly when an oil of low viscosity is of value because of ease in injection and greater fluidity, a diluted compound has been prepared. Experimenting with liquid petrolatum, olive oil, uniodized rapeseed oil, and finally ethyl olive oil, it was found that liquid petrolatum proved irritating; olive oil greatly increased the toxicity, and uniodized rapeseed oil gave a product with a viscosity slightly greater than could be obtained with ethyl olive oil. Ethyl olive oil was an ideal product because of its low specific gravity—0.867. In this manner a large amount of iodine shadow-casting properties is maintained in the final solution. Ethyl olive oil was prepared by Professor Roger Adams and Dr. E. H. Volwiler. It presents a mixture of the ethyl esters of the acids present in olive oil. It is prepared as follows: A mixture of olive oil, absolute ethyl alcohol and concentrated sulphuric acid is refluxed for four hours. The alcohol solution of ethyl esters formed is washed with 10 volumes of water. The esters are separated and dried with anhydrous sodium sulphate. If any ethyl alcohol is present, it is distilled off. The oil in this way is then further purified by distillation in vacuo (65 mm.) at temperatures ranging from 190 to 225° C.

By mixing four parts of campiocol with one part of ethyl olive oil, a fluent product was obtained with the specific gravity of 1.004. It is this oil that we recommend for use in the subarachnoid space, for arterial use, fistulae, mastoids, eustachian tubes, and outline of the female genitalia. The shadow it casts is entirely satisfactory and the oil can be readily injected. Dilution with ethyl olive oil does not increase the toxicity and tends to protect campiocol from deterioration.

In the outline of the nasal sinuses, an oil casting too great a shadow will not show all the details that are essential. The

minute details desired are clearly visualized by a mixture of 50 per cent ethyl olive oil and 50 per cent iodized rapeseed oil. This oil can be readily injected and drains satisfactorily from the sinus.

In order to emulsify campiodol, such agents as gelatine, tragacanth and acacia were utilized. It was found that acacia was the most desirable. The synthesis of campiodol and the emulsion are discussed in a separate paper (Glaser and Raiziss).

The use of campiodol and its modification products will be considered in the following body cavities.

1. Tracheobronchial tree (straight campiodol)
2. Subarachnoid space (4 to 1 dilution)
  - a. Spinal block
  - b. Ventricular visualization
3. Blood vessels (4 to 1 dilution)

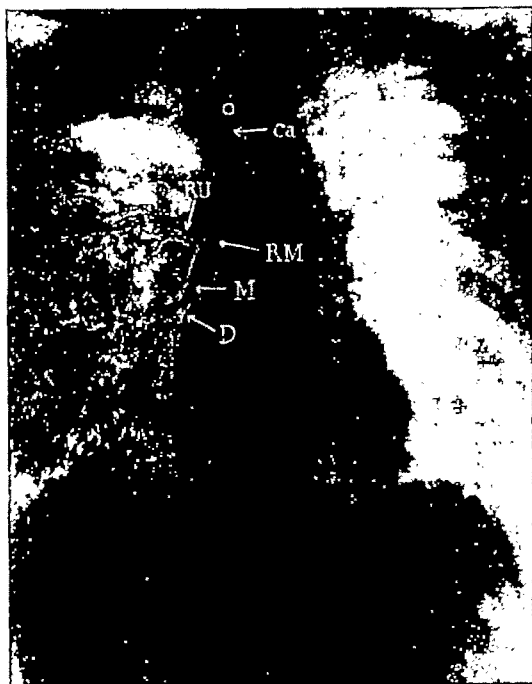


FIG. 2. The right lung is outlined with campiodol, but except for a narrowing between the middle and lower lobe bronchi, the plate is normal. Ca, catheter in the trachea; RM, right main bronchus; RU, right upper lobe bronchus; M, continuation of the right main bronchus below the upper lobe bronchus; D, point of division between the middle and lower lobe bronchi.



FIG. 3. Right-sided empyema which has so compressed the lung that the campiodol has been confined to the tracheobronchial tree. RU, right upper lobe bronchus; M, middle lobe bronchus; L, lower lobe bronchus; D, point of division between the middle and lower lobes.

- a. Cerebral
- b. Peripheral
4. Fistulae (4 to 1 dilution)
5. Maxillary sinus (50 per cent)
6. Genitourinary tract (emulsion)
  - a. Kidney pelvis
  - b. Bladder
  - c. Ureter
  - d. Urethra
7. In addition, the oil may be used to outline the female genitalia, the sphenoidal sinus, frontal sinus, the lacrymal ducts, the mastoids and the eustachian tubes.

#### VISUALIZATION OF THE TRACHEOBRONCHIAL TREE

Campiodol is of great value in clearing up obscure chest conditions, particularly when patients complain of persistent cough, expectoration, hemoptysis or chest pains in the absence of tubercle bacilli. It is contraindicated only in those cases

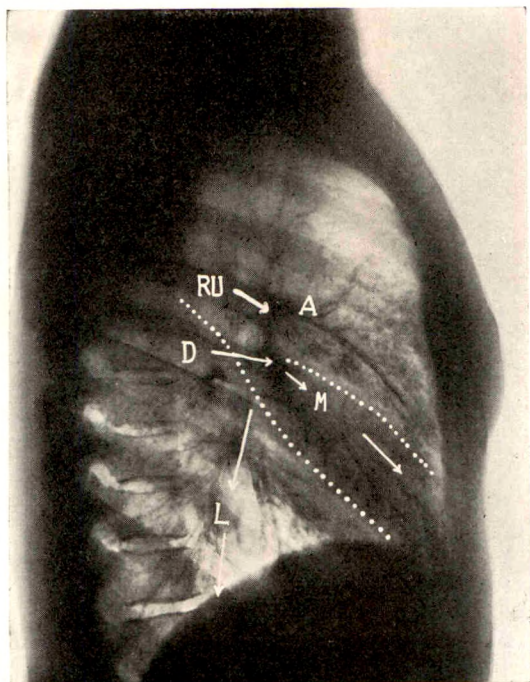


FIG. 4. Lateral view of the right lung showing the anterior direction of the middle lobe bronchus, M, and the posterior direction of the lower lobe bronchus, L. RU, right upper lobe bronchus; A, anterior branches of the upper lobe bronchus; D, point of division between the middle and lower lobe bronchi. The dotted lines indicate the division of the right lung into the upper, lower and middle lobes.

where the oil will lower the vital capacity below that of safety. Campioidol has not as yet been used in tuberculosis.

Since the introduction of iodized oil, many methods of injection have been employed by the various workers, all of which are of value and may be utilized in selected cases. It has been the experience of Dr. W. B. Faulkner, Jr., to have had more consistent results with the catheter method. Campioidol is introduced under the roentgenoscope. In this manner, the flow can be visualized. Roentgenograms are taken immediately. In certain cases where pus, foreign bodies or tumors occlude a bronchus, preliminary bronchoscopy must be carried out so that the intrabronchial obstruction is removed and a clear pathway is established for the entrance of the oil. In order to accurately diagnose

lung pathology, it is extremely important to visualize the normal tracheobronchial tree (Figs. 2, 3 and 4).

In the diagnosis of bronchiectasis, the use of campioidol is of paramount importance. Bronchiectasis may be classified by the shape of the diseased bronchi, such as fusiform, cylindrical and saccular. All of these forms may exist in the same patient. More important than this classification is the determination of the extent and location of the bronchiectatic process (Figs. 5 and 6).

Bronchostenosis may be divided into three types: inflammation, bronchial tumors and intrapulmonary tumors. In all of these cases, if the bronchi are completely obstructed, preliminary bronchoscopy is necessary (Fig. 7).

In empyema the use of campioidol should be limited to those cases where the physical signs and roentgen findings do not give conclusive evidence as to the extent

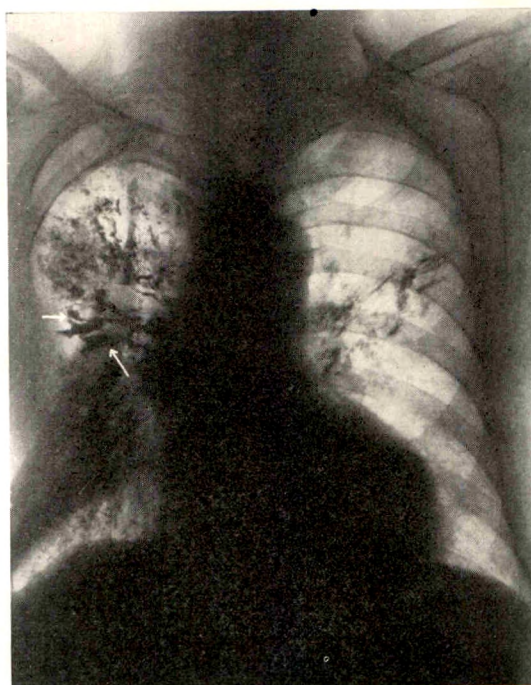


FIG. 5. Campioidol injection of the right lung in a patient who has had a partial lower posterior thoracoplasty. The arrows point to large dilated fusiform bronchi at the base of the right upper lobe. The bronchi of the lower lobe are normal.



of lung expansion on the diseased side. If the lung is not fully expanded, further treatment is necessary, particularly in those cases where closed drainage has been carried out.

Acute lung abscess can only be visualized if the bronchus leading to the abscess is not obstructed. If this bronchus is obstructed by pus, granulation tissue, or edema, preliminary bronchoscopic treatment is needed in order to clear the pas-

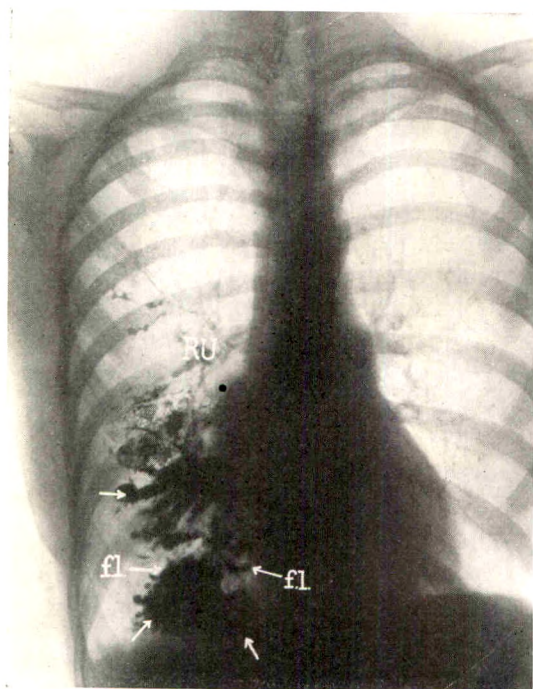


FIG. 6. Campidol injection of the right lung. Note the dilated bronchi at the right base. RU, right upper lobe bronchi. The arrows indicate the bronchiectatic areas in the middle and lower lobes; fl., fluid levels in the dilated bronchi.

sage way. Campidol should then be injected immediately. Chronic abscesses are more readily filled.

In cases of pleural pulmonary fistulae intratracheal injection of campidol will show collections of oil in the pleural cavity. External pleural cutaneous sinuses connecting with the lung through a bronchial fistula are readily recognized by campidol injection (Fig. 8).

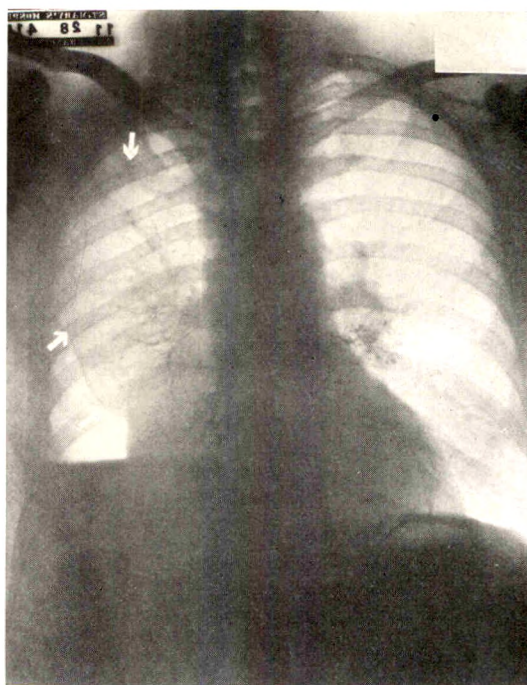


FIG. 7. Diffuse primary carcinoma of the lung with hydropneumothorax as well as atelectasis of the lower lobe. Diagnosis confirmed at autopsy.

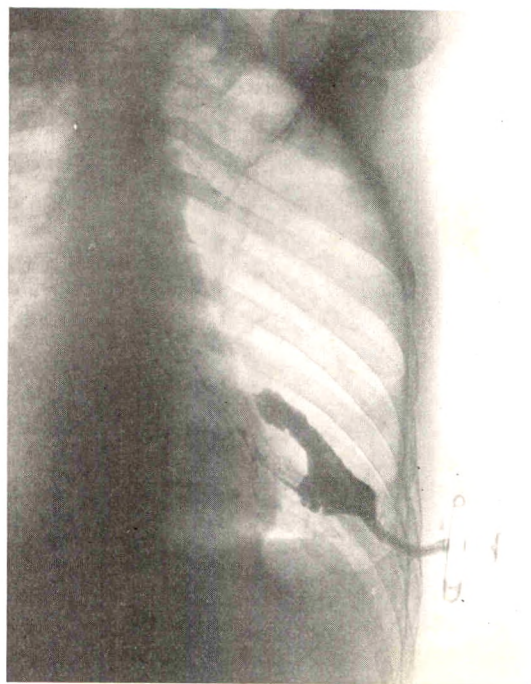


FIG. 8. The campidol has extended from the empyema pocket into the bronchi, indicating a bronchial fistula.



This emulsification of an ascending oil was tried with campiodol. A violent reaction resulted with a rise of temperature to 105° F. For this reason it is not advisable

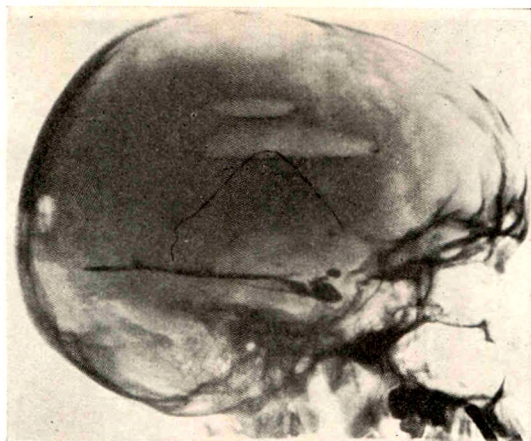


FIG. 13. Demonstration of an intraventricular tumor after the injection of 2 c.c. of iodized oil into the ventricles (4 to 1 dilution). Note the two air bubbles in the upper portion of the lateral ventricles.

to outline the ventricles by an ascending oil emulsion. If campiodol with a specific gravity slightly greater than that of spinal fluid is injected directly into the ventricles,

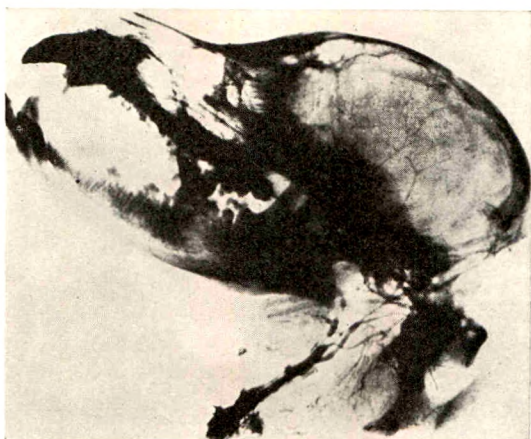


FIG. 14. The cerebral vessels of a dog's head are visualized after the injection of 5 c.c. of campiodol into the internal carotid artery.

a faint outline may be observed. This method succeeded in outlining a ventricular tumor (Fig. 13). Further researches

must be carried on before this use of campiodol can be of clinical importance.

The cerebral vascular system has been outlined by intracarotid injection with ligations of the external carotid. As yet, this has been utilized only in animals, but no toxic effects have been noted (Fig. 14). Egas Moniz has utilized sodium iodide by a similar method and has succeeded in diagnosing brain tumors. Further work must be carried out upon this method of cerebral localization.

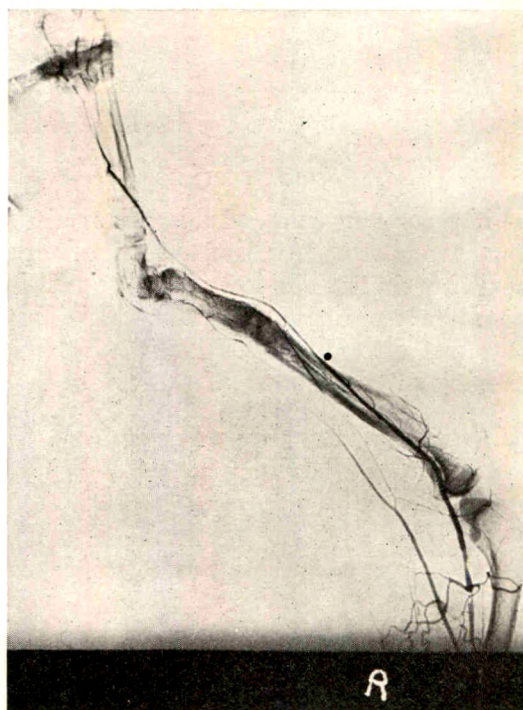


FIG. 15. The arteries in the hind leg of a dog are visualized after a femoral injection of 4 c.c. campiodol (4 to 1 dilution).

The peripheral vasculature may also be outlined by campiodol, 4 to 1 dilution. This is of value for the diagnosis of arterial obstruction and in experimental work (Fig. 15).

#### FISTULAE

Various body fistulae and abscesses may be readily outlined by the utilization of a 4 to 1 dilution (Fig. 16 and 17).



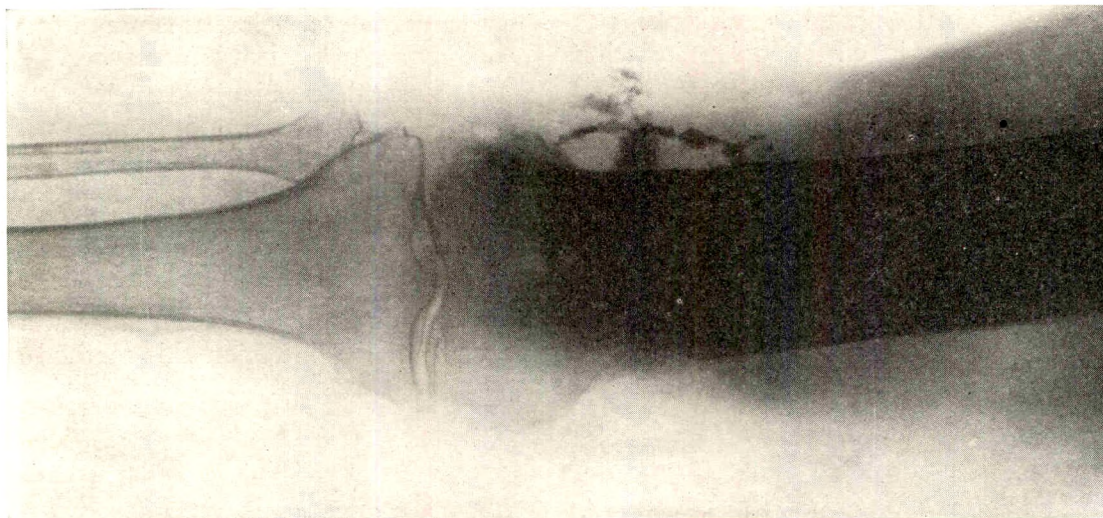


FIG. 16. The visualization of a sinus in a case of osteomyelitis.

#### MAXILLARY SINUS

Fifty per cent campiodol has proved the most satisfactory for the outline of the maxillary sinus. The low viscosity enables the oil to be injected without special syringes and also allows a shift of the oil in the sinus with change of position. This



FIG. 17. A fistula in the lumbar region clearly visualized.

gives an outline of all the sides of the sinus wall. Due to the diminished shadow casting property, the essential soft tissue details which must be clearly outlined are not obscured.

The maxillary sinus has various forms of pathology which must be accurately ascertained. The presence of pus, with or without thickening of the mucosa, chronic maxillary sinusitis with great thickening of the walls, or polypoid formation, dentigerous cysts, sarcoma, mucocele, etc., are among the more common pathological entities. In addition, there are abnormalities of the normal sinus, such as thickening of the wall, or undeveloped sinuses. In the young, before the sinuses are properly developed, the detail may be blurred by unerupted teeth, and in adults the density of the bone may be increased to such an extent as to be misinterpreted as sinus disease.

Clinical and roentgenographic evidence frequently fails to make the diagnosis accurately. By the use of campiodol, the exact thickness of the mucous membrane may be determined (Fig. 18), polyps may be diagnosed (Fig. 19), etc. In some cases where the mucous membrane is normal or slightly thickened, medical treatment will suffice, whereas in other cases where the mucous membrane is greatly thickened,



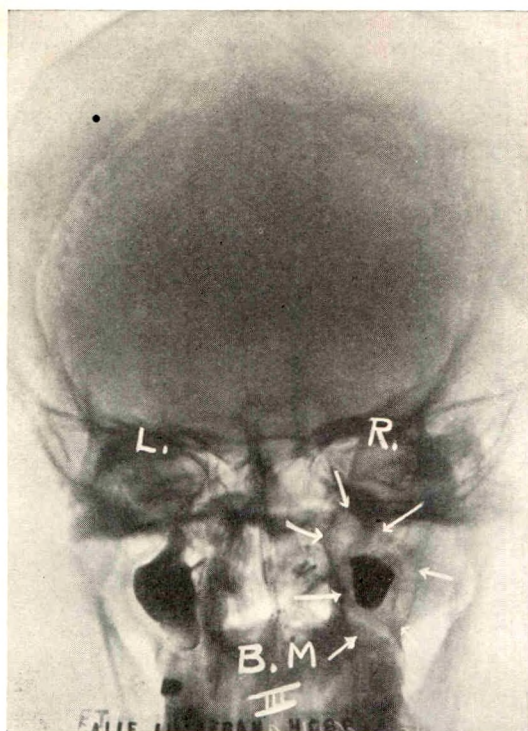


FIG. 18. Campioidol injection of both antra shows the wall of the right antrum thickened to about 8 mm., and the wall of the left antrum to be about 3 mm.

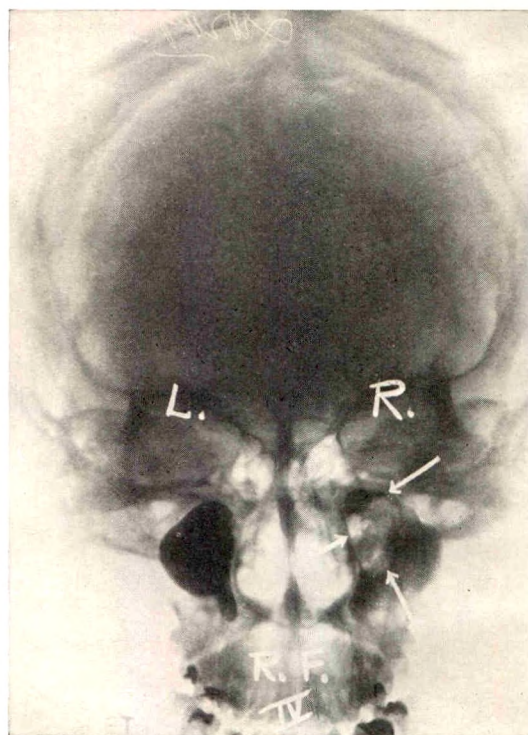


FIG. 19. The mucous membrane of the right antrum is 4 mm. thick with a polyp in the antranasal wall. The mucous membrane of the left antrum is about 3 mm. thick.

surgery is necessary. In order to gain the best visualization of the maxillary antrum, Glaser, Futch and Snure described a technique, with illustrations, by which the various sinus walls may be visualized. This will not be described in this paper, but it is sufficient to say that prone Waters, prone Granger, supine and prone lateral views were utilized with stereo Waters and supine laterals. The frontal sinus (Fig. 20) and the sphenoidal sinuses may also be outlined.

#### UROGRAPHY

Iodized oils, though casting satisfactory shadows, gained little favor in urography because of their increased viscosity and non-miscibility. The viscosity of these oils did not permit a ready flow into the kidney pelvis, unless special syringes were used and great pressure exerted. Adherence to the pelvic and ureteral mucous membranes prevented ready drainage and

frequently resulted in obstruction with consequent pain. Air, accidentally introduced, might produce a trap with a similar

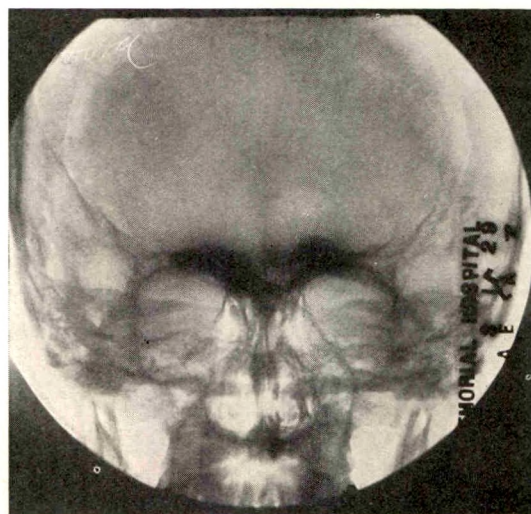


FIG. 20. A normal frontal sinus is outlined. (Injection by Dr. H. J. Hara.)



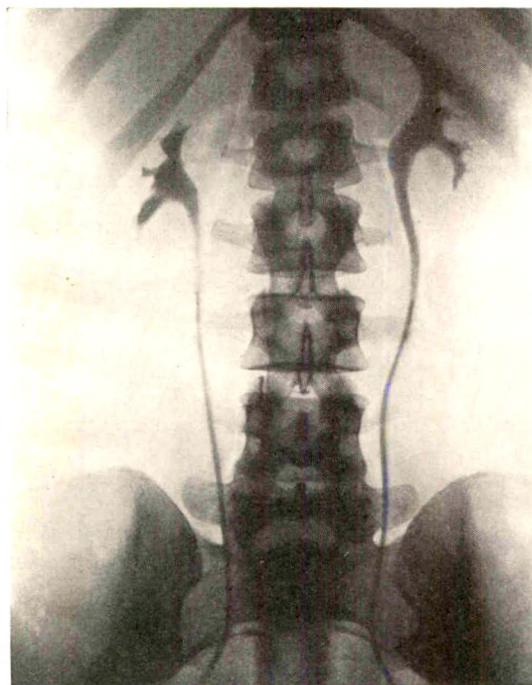


FIG. 21. Bilateral normal pyelogram.

result. The non-miscibility often gave distorted pyelograms hindering correct diagnosis.

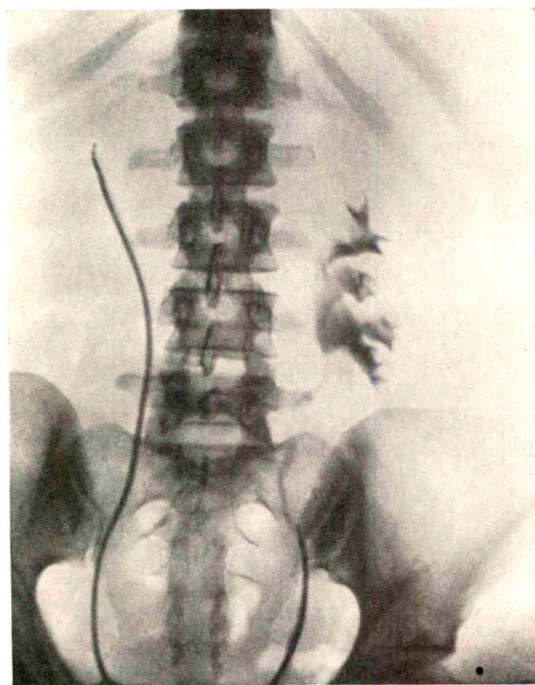


FIG. 22. Normal pyelogram.

Twelve and one-half per cent sodium iodide is quite satisfactory as a pyelographic medium, but as it is an electrolyte it irritates the mucous membrane, in many instances causing severe pain.

Uroselectan introduced for intravenous urography has a limited field of usefulness since in cases with poor kidney function the visual results are correspondingly affected and frequently the density of the excreted substance is insufficient for proper visualization.

Emulsified campidol is a grayish white

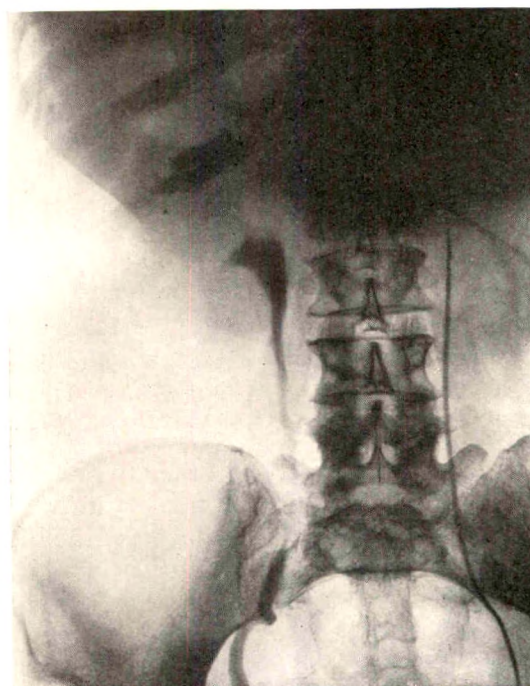


FIG. 23. A carcinoma of the right kidney.

substance, with a specific gravity of 1.078, and a viscosity of slightly more than twice that of water; it is non-irritating, non-toxic, and casts excellent shadows. By its use pain, burning and other signs of discomfort have been eliminated. It has been used successfully in over 300 cases (Glaser and Kutzmann, Kutzmann), giving satisfactory pyelograms, ureterograms, cystograms and urethrograms. As this emulsion is miscible with water, it is able to gain access into all the crevices, or openings in the urinary tract, giving



definition of the calyces, pelvis, ureter, even the papillae in the minor calyces being clearly outlined in detail. The slight viscosness of campiodol prevents reflux into the bladder as so frequently occurs with sodium iodide. This gives a good ureteral outline and eliminates bladder irritation.

The syringe method has been used because the emulsion is as yet slightly viscous for the gravity method; however, excellent pyelograms have been obtained by the gravity method with a 10 F. uretral catheter in place. The complaint of any

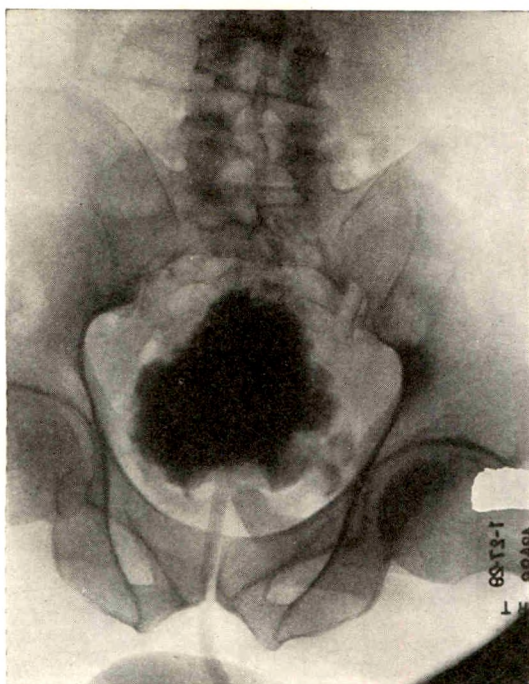


FIG. 24. A cystogram showing a trabeculated bladder.

pain or discomfort by the patient in the kidney or ureteral region is the signal for the cessation of injection. Further experimentation will be carried out to determine whether the emulsion cannot be made more adaptable to the gravity method (Figs. 21, 22, 23, 24, 25 and 26).

#### CONCLUSIONS

1. Iodized rapeseed oil, campiodol, is a stable, non-toxic oil containing approximately 43 per cent elemental iodine.

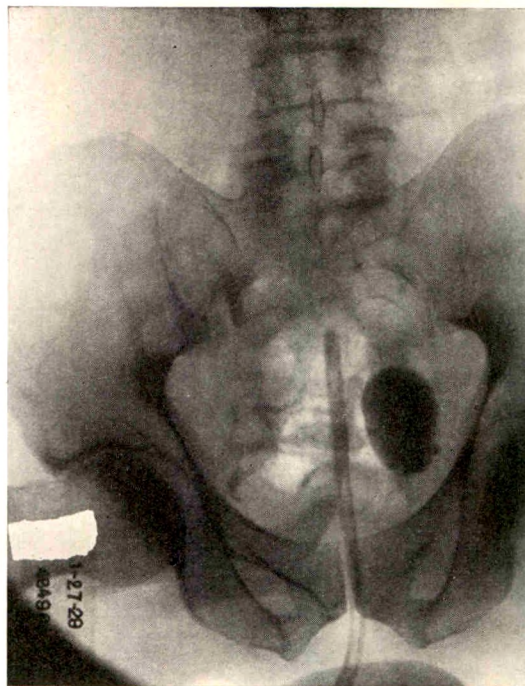


FIG. 25. A diverticulum of the bladder in the same case as Figure 24.

2. Straight iodized rapeseed oil is satisfactory for the outlining of the tracheo-bronchial tree.



FIG. 26. A normal urethrogram.

3. A 4 to 1 dilution with ethyl olive oil is satisfactory for outlining the spinal subarachnoid space, cerebral and peripheral blood vessels, the female genitalia, the lacrymal ducts, the mastoids and the eustachian tubes.

4. A 50 per cent dilution with ethyl olive

oil is satisfactory for outlining nasal sinuses.

5. Emulsified campidol is an inert, non-irritating substance and has been successful in urography, with a minimum of irritative symptoms.\*

\* Thanks are extended to Drs. H. K. Pancoast and E. P. Pendergrass of the University of Pennsylvania for their kind cooperation in the original research.

#### REFERENCES

1. EGAS MONIZ. Injection intracarotidiennes et substances injectables opaques aux rayons X. *Presse méd.*, 1927, 35, 969-971.
2. FRASER, ROBERT H. Diagnostic uses of lipiodol in the paranasal sinuses. *Bull. Battle Creek San. & Hosp. Clin.*, 1929, 24, 50; also *Radiology*, 1929, 12, 6-23.
3. FRAZIER, C. H., and GLASER, M. A. Iodized rape-seed oil (campidol) for cerebrospinal visualization. *J. Am. M. Ass.*, 1928, 91, 1609-1614.
4. GLASER, M. A., FUTCH, C. E., and SNURE, H. Iodized rapeseed oil (campidol) in the diagnosis of chronic maxillary sinusitis. *Ann. Otol., Rhin. & Laryng.*, 1929, 38, 1067-1094.
5. GLASER, M. A., and KUTZMANN, A. A. Emulsified campidol as a pyelographic media. *Ann. Surg.*, 1929, 90, 270-280.
6. KUTZMANN, A. A. The use of emulsified campidol in urography. *J. Urol.*, 1929, 22, 573-585.
7. MACCREADY, PAUL B. Iodized oil as an aid in the diagnosis of chronic sinusitis and of maxillary cysts. *Boston M. & S. J.*, 1926, 195, 464-467.
8. NEUSWANGER, C. H. Iodized oil a pyelographic medium. *Surg., Gynec. & Obst.*, 1926, 43, 169-176.
9. SACHS, ERNEST, and GLASER, M. A. Definite level symptoms suggesting spinal tumor. *J. Am. M. Ass.*, 1927, 88, 308-310.
10. SICARD, J. A., and FORESTIER, J. Diagnostic et thérapeutique par le lipiodol. Masson et Cie, Paris, 1928.
11. SICARD, J. A., and FORESTIER, J. Methode générale d'exploration radiologique par l'huile iodée (lipiodol). *Bull. et mém. Soc. d. chir. de Par.*, 1922, 46, 463-469.
12. SWICK, M. Intravenous urography by means of uroselectan. *Am. J. Surg.*, 1930, 8, 405-414.
13. WEIL, A. I., and HENDERSON, W. F. Use of lipiodol as aid to diagnosis of nasal sinus conditions. *New Orleans M. & S. J.*, 1928, 81, 426-432.



## MIKULICZ'S DISEASE AND THE MIKULICZ SYNDROME THEIR TREATMENT BY IRRADIATION

By T. LEUCUTIA, M.D.,  
*Department of Roentgenology, Harper Hospital*

and

A. E. PRICE, M.D.,  
*Department of Medicine, Harper Hospital*

DETROIT, MICHIGAN

### HISTORY AND CLASSIFICATION

IN JANUARY, 1888, Mikulicz<sup>114</sup> presented before the Society of Scientific Medicine of Königsberg a man forty-two years of age, who had a symmetrical enlargement of the lacrymal and salivary glands. The minutes of the meeting established briefly that "both lacrymal and all salivary glands were symmetrically tumefied, resulting in marked swelling of these organs and considerable disfiguration of the face. The tumefactions developed gradually and they were at the time of the examination of hard consistency, painless, and without any manifestation of an inflammatory reaction. No other pathological change could be demonstrated in the patient affected with these tumors." Although Mikulicz, at that time, did not attempt to interpret the findings in his case, it is clear that he was dealing with an entirely new condition for which he could find no analogy in the literature and which has since been named "Mikulicz's disease" in his honor.

Shortly after this first communication, new reports appeared by Haltenhoff,<sup>69</sup> Fuchs,<sup>59</sup> Zirm,<sup>189</sup> and de Wecker and Masselon,<sup>181</sup> all emphasizing the bilateral symmetrical character of the lesion and the simultaneous involvement of the lacrymal and one or more pair of the salivary glands.

In 1892, Mikulicz<sup>114</sup> described in detail the chief characteristics of the disease, which he now considered a distinct clinical and pathological entity. He stated that the point of attack is most probably through the lacrymal glands, which occasionally, as in the case of Arnold and Becker,<sup>5</sup> may appear to be the only organ involved. When the disease is fully developed, there is evidence of a hyperplasia of the lymph-

adenoid tissues of the affected organs, probably due to a chronic infection. One of the important criteria of the lesion is that "the process remains localized exclusively to the lacrymal and salivary glands and that there is no extension, either to the neighborhood or to other organs and tissues." This, as we shall see, is still the main factor differentiating Mikulicz's disease proper from the so-called Mikulicz syndrome which was established later. For the same reason Mikulicz rejected the cases of Reymond<sup>144</sup> and Adler,<sup>3</sup> in which there was evidence of concomitant enlargement of the lymph nodes and spleen, as not belonging to the entity considered by himself typical of the disease proper.

Following Mikulicz's publication, numerous individual case reports appeared in the literature. Some of these cases (Snell,<sup>166</sup> Debierre,<sup>36</sup> Laffolley,<sup>96</sup> Jayle,<sup>85</sup> Küttner,<sup>94</sup> Kümmel,<sup>93</sup> Baas,<sup>12</sup> Cheinisse,<sup>25</sup> Meller,<sup>108</sup> Tietze,<sup>175</sup> and others) were considered as true forms of Mikulicz's disease, but other cases (Cutler,<sup>34</sup> Haeckel,<sup>66</sup> Marcuse,<sup>103</sup> v. Duyse,<sup>41</sup> and others) because of the simultaneous involvement of the lymph nodes and spleen, were classified as aleucemic stages of pseudoleucemia and again other cases (Gallasch,<sup>60</sup> Dunn<sup>39</sup>) were placed in the group of true lymphatic leucemia.

v. Brunn,<sup>22</sup> in 1906, attempted to classify the variations of Mikulicz's disease on an anatomic basis. Thus he distinguished between two main groups: those without blood changes and those with blood changes. Those without blood changes are localized to the lacrymal and salivary glands alone or there may be a concomitant involvement of the lymph nodes and spleen. The forms with blood changes may consist in lymphatic

pseudoleucemia with severe anemia,<sup>22</sup> or they may represent true lymphatic leucemia.<sup>60,39</sup> Those types with involvement of only one pair of glands, as, for example, the lacrymal glands (cases of Arnold and Becker,<sup>5</sup> Power,<sup>136</sup> Abadie,<sup>1</sup> de Lapersonne,<sup>98</sup> Pick,<sup>128</sup> Stoewer,<sup>169</sup> Shoemaker,<sup>169</sup> and others), or the salivary glands (Kümmel<sup>93</sup>) alone, are also placed in the group of Mikulicz's disease proper.

Howard<sup>82</sup> after making a detailed critical study of all cases recorded up to his time (1909), arrived at the conclusion that Mikulicz's disease is not an entity but merely a syndrome. Thus he says: "The weight of evidence is in favor of the contention that Mikulicz's disease is merely a clinical syndrome very much as are tetany, epilepsy, etc. For in the literature there are cases illustrating all stages of gradation between the strict Mikulicz type and the most characteristic leukaemia. Furthermore, some cases reported as Mikulicz's disease have later in their course been classified as pseudoleukaemia (Marcuse's case<sup>103</sup>); and others considered pseudoleukaemia have before death proved to be very chronic cases of leukaemia (Stock's case<sup>168</sup>)." For purposes of convenience, Howard grouped the cases collected from the literature under three heads: (1) Mikulicz's disease proper; (2) pseudoleucemia, and (3) leukemia. Like v. Brunn, he included under the head of Mikulicz's disease proper, the latent forms (*formes frustes*) of Mikulicz's disease, that is, forms involving either the lacrymal glands (same cases as v. Brunn; also a case of v. Reuss<sup>143</sup>) or any pair of the salivary glands alone, as, for instance, the parotids (cases of Laffolley,<sup>96</sup> Kümmel,<sup>93</sup> Quinke,<sup>138</sup> Minelli,<sup>115</sup> and Apert<sup>4</sup>), the submaxillaries (Kümmel<sup>93</sup>) and sublinguals (Reinbach,<sup>142</sup> Concetti,<sup>30</sup> and others).

As simple as this classification of Howard may appear, it has the disadvantage that it does not cover all the conditions which might produce the so-called Mikulicz syndrome. Thus soon after the publication of Howard's work, a number of articles

appeared—especially from the French and more recently from South American sources—which emphasized the part of syphilis in the production of the syndrome. Then other investigators found that tuberculosis, chronic absorption of toxins (Zeigler<sup>188</sup>), gout, and certain tumors such as lymphosarcoma, lymphangioma (Hagenbach<sup>68</sup>), carcinoma (Smith and Bump<sup>164</sup>), and subfacial lipomas (Koettwitz<sup>89</sup> and Hofmeister<sup>80</sup>), may lead to a picture similar to that originally described by Mikulicz. Finally it was observed that physiologic hypertrophy of the lacrymal or salivary glands (Jayle,<sup>85</sup> Frenkel,<sup>55</sup> Sarda<sup>151</sup>), familial or hereditary tendencies and the so-called uveoparotid fever may also play a part in the production of the syndrome.

For this reason, Thursfield,<sup>174</sup> in 1913, elaborated a classification which would include all lesions showing a symmetrical enlargement of the lacrymal and salivary glands. Thus he established eight groups: (1) congenital, familial and hereditary condition; (2) Mikulicz's disease proper; (3) Mikulicz's disease with involvement of the lymphatic apparatus; (4) leukemia; (5) tuberculosis; (6) syphilis; (7) gout, and (8) sialodochitis fibrinosa. This classification, although more complete than any previously mentioned, still has the disadvantage that it fails to coordinate the various conditions leading to the Mikulicz syndrome according to their incidence and importance. Therefore, Schaffer and Jacobsen<sup>155</sup> more recently classified the syndrome "in much the same fashion as has been done for purpuras, by dividing them into two large groups, a symptomatic and idiopathic, as follows:

#### I. Mikulicz's Disease

- A. Familial
- B. Mikulicz's disease proper

#### II. Mikulicz's Syndrome

- A. Leucemia
- B. Tuberculosis
- C. Syphilis
- D. Lymphosarcoma
- E. Toxic



1. Lead
2. Iodides, etc.
- F. Gout (?)
- G. "Febris uveoparotidea sub-chronica."

The "syndrome" nature of Mikulicz's disease was emphasized more recently also by v. Hase,<sup>74</sup> Fromowicz,<sup>58</sup> Stoppato,<sup>170</sup> Formiggini,<sup>53</sup> Raybaud,<sup>141</sup> Daniel,<sup>35</sup> and others. Clarke<sup>27</sup> described the association of Mikulicz's disease with Erb's juvenile dystrophy, Nolan<sup>123</sup> with dementia praecox, Schmidt<sup>157</sup> with paralysis agitans and Wood<sup>185</sup> with Graves' disease.

#### REVIEW OF IRRADIATION PROCEDURES

It is only natural that the rather indefinite knowledge of the true nature of Mikulicz's disease proper, and especially as to what to include under the heading of the Mikulicz syndrome, should have led to confusion in the determination of the proper method of treatment by radiation and the estimation of the results obtained therefrom. Indeed, while in some instances the response to treatment was truly remarkable, permanent cures having not infrequently been obtained; in others, no benefit whatever could be observed from the irradiation. This is further complicated by the fact that the therapeutic application of radium, and more especially of roentgen rays, has undergone such radical changes during the past twenty-five years, that a comparison of techniques, and therefore of results, now appears practically impossible.

Still, a careful survey of the literature shows that the increase in the penetration of the rays, which was the result of gradual improvement in machines and technique, was followed by a corresponding increase in the percentage of permanent cures. It seems wise, therefore, to briefly review the most important articles reflecting the salient changes in the practical application of radiation so as to arrive at a better evaluation of the most suitable technique for the treatment of Mikulicz's disease

proper and the various conditions comprising the Mikulicz syndrome.

As in the irradiation of all other diseases, radiation therapy of Mikulicz's disease was started with very soft, unfiltered roentgen rays, the time of exposure being the only factor which held the interest of the different investigators. Thus Fittig<sup>50</sup> (1904), Ranzi<sup>140</sup> (1905) and Pfeiffer<sup>127</sup> (1906) have treated their cases with exposures of from 42 to 360 minutes over each side of the face. In all instances there was immediate improvement, but while in the cases of Fittig and Ranzi the improvement lasted for only a few years, in the case of Pfeiffer, which received the largest amount of radiation (360 minutes on the left side and 240 minutes on the right side of the face) the improvement was permanent. It should also be mentioned that while in the cases of Fittig and Ranzi the involvement was localized to the parotid glands alone, in the case of Pfeiffer there was involvement of the parotids, lacrymal and submaxillary glands. A somewhat similar treatment was employed by van Duyse<sup>41</sup> (4 seances of 10 minutes each, 6 Benoist hardness, 4-5 Holzkecht units) and Haenisch<sup>67</sup> (7 sittings of 10 minutes each, 13 Wehnelt hardness, 20 cm. distance, Perthes' filter). In both instances there was good response to irradiation and within one to one and a half years, there was no recurrence. Similar results with nearly identical technique were reported by Freund,<sup>56</sup> Barjon and Lacour,<sup>14</sup> Lacous,<sup>95</sup> Simon,<sup>103</sup> Séjournet,<sup>158</sup> Duranti,<sup>40</sup> and Sausol,<sup>153</sup> the last reporting several cases of permanent cures.

With the advent of the aluminum filter, we see its gradual introduction also in the treatment of Mikulicz's disease, first in a thinness of fractions of a millimeter, later in layers of several millimeters. Thus Chuiton and Aubineau<sup>26</sup> employed 0.5 mm. Al (7-8 Benoist hardness, 2 ma, tint B Sabouraud), while Lüdin<sup>101</sup> used 2 mm. Al (125-130 Sklero hardness,  $\frac{1}{2}$ -1 Sabouraud) as filter. Later use of increasing thicknesses of aluminum and zinc filters

and, in some instances, rather penetrating roentgen rays (up to 150 kv.) was reported by Cogolli,<sup>23</sup> Moorhead,<sup>117</sup> Hörhammer,<sup>81</sup> Abraham,<sup>2</sup> Ziegler,<sup>187</sup> Lintz,<sup>100</sup> Samaja,<sup>150</sup> Vallery-Radot, Gilbert, Blamoutier and Weyland,<sup>177</sup> Astier,<sup>8</sup> Wright,<sup>186</sup> Popp,<sup>133</sup> Scales,<sup>154</sup> Radcliffe,<sup>139</sup> Ross and Shephard-Walwyn, and others. In all these instances, the irradiation led to more or less satisfactory results, not infrequently with long periods of remissions or even permanent cures.

The beneficial effect of radium which no doubt constitutes the hardest type of radiation available, was emphasized by Bartlett,<sup>15</sup> Pinch,<sup>129</sup> and especially by Hamburger and Schaffer.<sup>70</sup> These latter have treated a case of uveoparotid fever, which has remained well for a period of five years. A combination of roentgen rays over the salivary glands and radioactive substances over the eyes was used to advantage by Chuiton and Aubineau<sup>26</sup> (radium) and Marcotty<sup>102</sup> (mesothorium).

More recently, however, several reports have appeared in the literature as, for instance, those of Courchet,<sup>32</sup> Askey,<sup>7</sup> Schaffer and Jacobsen<sup>155</sup> and especially of Griffith<sup>63</sup>, which deny the beneficial action of the roentgen rays in some forms of Mikulicz's disease. Thus Schaffer and Jacobsen write as follows of two of their cases: "While in the hospital, the patients received systematic roentgen ray exposure of the parotid glands, but without noticeable effect;" and again Griffith says: "In my own case, roentgen ray treatment was without benefit." In one of the cases of Vallery-Radot et al.<sup>177</sup> there was likewise no response of the affected glands to radiation.

In attempting to estimate the value of radiation in the various forms of Mikulicz's disease, we believe that due attention must be paid to the type of the lesion we have to deal with. It is quite natural to assume that Mikulicz's disease proper which *a priori* is a chronic condition of long duration, should show a more favorable response to radiation with regard to the

ultimate outcome than would be the case with the Mikulicz syndrome in leukemia, generalized lymphosarcoma and some forms of very far advanced tuberculosis. In many of the above publications, which are nearly all individual case reports, sufficient distinction is not made between the different types of Mikulicz's disease regarding their response to irradiation, and consequently the conclusions arrived at are often contradictory and uncertain. This is especially true when the method of procedure and the dose applied are considered.

For this reason, we prefer to divide the cases treated by us as is done by Schaffer and Jacobsen,<sup>155</sup> into different groups, and thus to consider them in the light of the characteristics of that particular group, both from the pathological and therapeutic standpoint.

Our series includes 9 cases, 2 of which are pure types of Mikulicz's disease proper, 3 belong to the leukemia group, 2 are cases of tuberculosis, one a lymphosarcoma and one a Hodgkin's disease with involvement of the parotid glands.

#### MIKULICZ'S DISEASE PROPER

This condition consists, as originally described by Mikulicz<sup>114</sup>, in a painless, non-inflammatory, symmetrical swelling of the lacrymal and one or more pair of the salivary glands, without involvement of the lymphatic system and without alteration of the blood. The general health of the patient is affected but little and the disease is of comparatively long duration, the average, according to Lane,<sup>97</sup> being seven and a half years, but cases living as long as fifteen years have been recorded. In some instances there is a secondary swelling of the upper eyelids and skin of the face, leading to a slit eye or "bloodhound eye appearance" (Ziegler<sup>188</sup>). Because of the involvement of the lacrymal and salivary glands, there is often a dryness of the eyes and of the mouth, sometimes accompanied by a peculiar deafness (Samaja<sup>150</sup>). The dryness of the eyes may lead to conjunc-

tival and corneal complications, while the dryness of the mouth may produce ulceration of the mucous membrane of the mouth and gastric disturbances.

It is interesting that intercurrent acute infections not infrequently lead to partial or complete disappearance of the enlargement of the affected glands with prompt recurrence of the enlargement as soon as the infection subsides. Thus Mikulicz<sup>114</sup> himself observed a reduction in the size of the glands following peritonitis, while a nearly complete disappearance of the disease was observed by Zirm<sup>189</sup> and Quinke<sup>138</sup> following erysipelas, by Kümmel<sup>93</sup> following pneumonia and influenza, by Guillaud, Kudelski and Lieutaud<sup>64</sup> following encephalitis, and by Haeckel<sup>66</sup> following simple enteritis. In some instances, Mikulicz's disease is of the abortive type, as in the cases of Souques and Chéné,<sup>167</sup> Gouget,<sup>62</sup> de Jong and Joseph,<sup>87</sup> Sicard,<sup>161</sup> Sicard and Leblanc,<sup>162</sup> Méry, Girard and Mercier-Desrochettes,<sup>111</sup> Weissbach,<sup>184</sup> Sabrazès,<sup>149</sup> and others.

Since the etiology of Mikulicz's disease proper is unknown, great speculation arose in the literature as to the true nature of the disease. This was further complicated by the fact that the small round cells which on microscopic examination were found to invade or replace the organs affected, were variously interpreted as being due to a reactive process or to hyperplasia of the lymphoid tissue elements. The followers of the first theory (Mikulicz,<sup>114</sup> Hirsch,<sup>79</sup> Ranzi,<sup>140</sup> Haeckel,<sup>66</sup> Haenisch,<sup>67</sup> Külbs,<sup>92</sup> Portman,<sup>134</sup> and others) naturally assumed that the condition was a chronic inflammation, while the followers of the second theory considered it a more or less benign new growth. Of this latter group, Kümmel<sup>93</sup> was especially emphatic in separating Mikulicz's disease proper from all other allied conditions, and he suggested the use of the term "achroacytosis," while others advised the term "nonaggressive lymphadenoid hyperplasia."

v. Brunn<sup>22</sup> after observing a case of

Mikulicz's disease develop into a leucemia, advanced the opinion that "the symmetrical swelling of the lacrymal and salivary glands and leucemia must have a common cause." Howard<sup>82</sup> in further elaborating this theory, states that "a whole series of cases exists forming links in the chain from isolated lymphomata of the lachrymal or salivary glands to complete involvement of these glands with simultaneous disease of the lymphatic and hematopoietic apparatus."

This theory, that Mikulicz's disease progresses from the disease proper—through pseudoleucemia—to the true lymphatic leucemia and that consequently, under the best conditions, it represents an "aleukemic stage of pseudoleukemia" was endorsed by a great number of investigators, such as Marcuse,<sup>103</sup> Krause,<sup>91</sup> Broeckert,<sup>21</sup> Caspary,<sup>23</sup> Meller,<sup>108</sup> Pfeiffer,<sup>127</sup> Snegireff,<sup>165</sup> Voit,<sup>179</sup> Thaysen,<sup>172</sup> Lüdin,<sup>101</sup> Paton,<sup>126</sup> Hempelmann,<sup>77</sup> Cogolli,<sup>28</sup> Schmidt,<sup>156</sup> Fridericia,<sup>57</sup> Munck,<sup>119</sup> and others. More recently Schaffer and Jacobsen,<sup>155</sup> after analyzing in detail the evidence presented by the various investigators, and especially by Howard,<sup>82</sup> in favor of the leukemic character of Mikulicz's disease as a whole, arrived at the conclusion "that leukemia, when it does occur,—in conjunction with Mikulicz's disease—is invariably primary," and that "though every case of Mikulicz's syndrome is possibly one of leukemia, Mikulicz's disease proper is not potential leukemia." They also presented "evidence against the time honored theory of the progression of Mikulicz's disease from the disease proper, through pseudoleukemia to leukemia."

For this reason, Schaffer and Jacobsen plead for the re-establishment of Mikulicz's disease proper as a separate entity. A similar opinion is expressed by Smith and Bump,<sup>164</sup> who say: "There seems to be a definite group of patients, like the patient of Mikulicz's report, where disease has a long course without effect upon the general health or life of the patient, and hence, with a wholly different prognosis than

that of leucemia." The separate entity of Mikulicz's disease proper was emphasized also by Harmel,<sup>73</sup> Middeldorpf and Moses,<sup>113</sup> Dunn,<sup>38</sup> Aubineau,<sup>10</sup> Atkinson,<sup>9</sup> Arnst,<sup>6</sup> Fisher,<sup>49</sup> Barbick,<sup>13</sup> New,<sup>122</sup> Franke,<sup>54</sup> McKenzie,<sup>107</sup> Cooper,<sup>31</sup> Faure,<sup>47</sup> Evans,<sup>44</sup> and others.

From the point of view of radiation therapy, the most important criterion of Mikulicz's disease is its local histologic appearance. The lymphocytic infiltration, regardless of whether it is of a chronic inflammatory or of a benign neoplastic origin, shows a good response to irradiation. Still, if one compares this response with that of more malignant lymphocytic proliferations, a variation in degree of the radiation sensitivity is easily recognized. Thus while lymphatic leucemia, pseudo-leucemia and especially lymphosarcoma rapidly disappear, one may say "melt away," following the administration of a certain dose of roentgen rays or radium, the "lymphocytic infiltration" or the "lymphadenosis" of true Mikulicz's disease shows a response which is considerably slower. This is due in the first instance to the variation in degree of differentiation of the lymphocytes in the two types of lesions, and secondly to the organized structural arrangement of the lymphocytes in Mikulicz's disease. Ewing<sup>46</sup> already called attention some time ago to the fact that the lymphocytes of the tonsils, for example, are "on account of their arrangement in the organized structure of the lymphnode" less sensitive to radiation than the lymphocytes of malignant neoplasms. The same observation was made by Evans and Leucutia<sup>45</sup> who said that "when the organized structure of the lymphnode is maintained, even in the hyperplastic processes, a heavier irradiation is necessary in order to destroy the lymphocyte, than one would expect according to observations made on the roentgen effects on lymphocytes when in the circulating state, or in neoplastic transformation." That an organized structure of the lymphocytic proliferations or invasions in

the glands affected in Mikulicz's disease exists is amply proven by the investigations of v. Brunn,<sup>22</sup> Thaysen<sup>172</sup> and especially Minelli.<sup>115</sup>

From the point of view of technique of irradiation this, then, means that divided doses spread over a longer period are more beneficial in Mikulicz's disease than the one single massive dose as administered, for instance, in lymphosarcoma. For the same reason, the penetration and consequently the hardness of the rays is of considerably less importance. Thus we find that nearly all cases described in the literature, which were cured, received two or more series of irradiations with rays of various qualities.

In our cases, a dose of from 15 to 50 per cent S.U.D. was administered over the affected glands, and the treatment was repeated within three to eight weeks for two or three series. The quality of the roentgen rays used was: 0.13-0.14 Å (200,000 volts, 1 mm. Cu and 1 mm. Al as filters).

CASE I. Mrs. E. B., white, aged forty-two.

History of Present Illness. Since 1919 patient had had a painless swelling in the region of both parotid glands, which for the past two years had markedly increased in size, more so on the left side than on the right. Throughout the entire course, this condition was accompanied by extreme dryness of the mouth.

In 1927, the patient developed photophobia, a burning sensation and increased lacrymation in both eyes, all of which had become more marked during the past four months.

Except for bilateral mumps when eight years of age, the past history was negative. No other member of the family had ever had a similar condition.

Physical Examination 4-18-29. The patient was a well developed and nourished adult female.

In the region of both parotid glands, there was a painless, non-inflammatory, moderately soft swelling, somewhat more pronounced on the left side (Fig. 1). There was also marked enlargement of both submaxillary glands and moderate enlargement of both lacrimal glands.

The conjunctivae were chronically inflamed, both eyes lacrymating excessively. The right



cornea showed paracentrally an oval-shaped leucoma about  $1 \times 1.5$  mm. in size, surrounded by nebulous areas scattered throughout practically the entire anterior surface. A similar, though somewhat less extensive, condition

mm. Al as filters, water-cooled Coolidge tube, 15 ma, 40 min., 600 ma-min., 330 r, 50 per cent S.U.D.

4-19-29. Right side of face, identical technique.

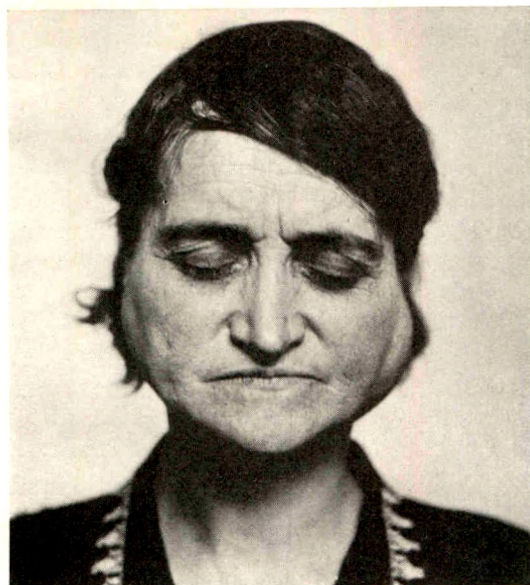


FIG. 1. Symmetrical enlargement of both parotid, submaxillary and lacrymal glands (Mikulicz's disease proper) of ten years' duration.



FIG. 2. Same as Figure 1, following roentgen irradiation with fractional doses.

existed on the left side. In neither eye was there involvement of the iris and both anterior chambers were clear. Because of the marked corneal opacities, a satisfactory fundus examination could not be made.

The mucous membranes of the mouth were dry. The orifices of Stensen's ducts showed no inflammatory reaction about them.

There was no enlargement of any of the superficial lymph nodes. No enlargement of the spleen or liver.

**Laboratory Data.** Urinalysis negative. Blood count: hb, 55 per cent; red blood cells, 3,720,000; white blood cells, 5,800; polymorphonuclears, 59 per cent; lymphocytes, 27 per cent; transitionals, 9 per cent; eosinophiles, 5 per cent. Normal morphology. Blood chemistry normal. Van den Bergh negative in both direct and indirect test. Blood fragility normal.

**Clinical Diagnosis.** True form of Mikulicz's disease.

**Treatment:** 4-18-29. Left side of face,  $10 \times 10$  cm. field, 65 cm. skin target distance, 0.13 Å eff. wave length, 200 kv., 1 mm. Cu, 1

7-2-29. Marked reduction in the size of the swelling of the parotid and submaxillary glands. Condition of the eyes unchanged. At this time treatment was repeated and extended also to the eyes. The dose and technique of exposure for the face were the same as previously, while for the eyes the dose was reduced to only 20 per cent S.U.D.

8-21-29. The swelling of the face had entirely disappeared (Fig. 2), but the condition of the eyes remained the same. For this reason, treatment over the eyes was repeated, the same dose being used as on 7-2-29.

In February, 1930, the general health of the patient was good. The face was normal in appearance, except for the marked photophobia which persisted. The lesions of the eyes remained unchanged.

**Comment.** The case is that of a symmetrical enlargement of both parotid, submaxillary and lacrymal glands (Mikulicz's disease proper) of ten years' duration. The condition was complicated by extensive lesions of the conjunctiva and cornea.





FIG. 3. Symmetrical enlargement of both parotid glands with beginning involvement of the lacrymal glands (Mikulicz's disease proper) of about two years' duration.

Following the administration of roentgen therapy, the enlargement of all glands affected disappeared, but the lesions of the eyes, which no doubt represented sequelae of an old chronic inflammation—probably on the same basis as the Mikulicz's disease itself—failed to heal.

CASE II. M. C., aged twelve, white, adolescent boy.

History of Present Illness. In 1927, patient first developed a bilateral enlargement of the parotid glands, which regressed spontaneously after a period of several months, although according to mother's statement, the appearance of the face never returned to normal. In September, 1929, the swelling of both parotid glands again became very pronounced, and for this reason the patient was brought to Harper Hospital for examination and treatment. At no time had there been fever, pain or tenderness. There was no history of dryness of the mouth.

Just previous to his admission to the hospital, the patient noticed some puffiness below the left eye, accompanied by moderate lacrymation.

Except for measles and whooping cough, the past history was negative.

Physical Examination 10-29-29. The patient was a moderately well-developed and nourished adolescent boy.

There was a slight puffiness below the left eye and a slight enlargement of the lacrymal glands. On either side of the face, there was a



FIG. 4. Same as Figure 3, following roentgen irradiation with fractional doses.

rather firm, painless, non-inflammatory swelling in the region of the parotid gland (Fig. 3). There was no involvement of the other salivary glands, no dryness of the mouth, and no inflammation around the papilla of Stensen's ducts.

There was no lymphadenopathy, and no enlargement of the spleen or liver.

Laboratory Data. Urinalysis negative except for a trace of glucose. Blood count: hb, 70 per cent; red blood cells, 3,900,000; white blood cells, 8,500; polymorphonuclears, 62 per cent; lymphocytes, 17 per cent; transitionals, 21 per cent.

Clinical Diagnosis. Bilateral, symmetrical enlargement of the parotid glands (true form of Mikulicz's disease).

Treatment: 10-29-29. Left and right side of face (2 areas)  $10 \times 15$  cm. fields, 60 cm. skin target distance, 0.14 Å eff. wave length, 200 kv., 1 mm. Cu, 1 mm. Al, as filters, water-cooled Coolidge tube, 20 ma., 5 min., 100 ma-min., 130 r, 20 per cent S.U.D.

11-12-29. There was a slight reduction in the size of the enlarged glands. At this time the treatment was repeated including the eyes within the field of irradiation. The same dose and technique of exposure were used as on 10-29-29.

12-2-29. There was a marked reduction in the size of the enlarged glands, and the lacrymation of the left eye had practically disappeared. Treatment was repeated with the same dose and technique as previously used.

2-13-30. The condition was apparently healed. The face and eyes were normal in ap-

pearance (Fig. 4) and the patient was entirely symptom-free. The blood count was normal.

*Comment.* The case is that of a symmetrical enlargement of both parotid glands with beginning involvement of the lacrymal glands (Mikulicz's disease proper) of about two years' duration. Following the administration of roentgen therapy, the condition healed and all symptoms disappeared.

Since in many instances a decrease of the swelling of the affected glands was observed following the administration of iodides and arsenic (Harmel,<sup>73</sup> Franke,<sup>54</sup> Romme,<sup>147</sup> Egerton,<sup>42</sup> Olsho<sup>124</sup>), it is sometimes advisable to associate the use of these drugs with the roentgen therapy. If the dryness of the mouth and eyes is very pronounced, the oral administration of pilocarpine, in doses of 5 milligrams given twice daily one-half hour before meals (Vallery-Radot et al.<sup>177</sup>) will produce symptomatic improvement.

It has been suggested by some investigators that in Mikulicz's disease proper, a surgical removal of the lacrymal glands should be attempted since in many instances a spontaneous clearing up of the other affected glands followed such a procedure (Mikulicz,<sup>114</sup> Kümmel,<sup>93</sup> Paton,<sup>126</sup> Elliot and Ingram,<sup>43</sup> and especially Hijmans van den Bergh,<sup>78</sup> and others). It seems to us, however, that in view of the very satisfactory results obtained by irradiation, surgical intervention is unwarranted.

The fact should also be mentioned here that since no definite criteria exist for the accurate diagnosis of Mikulicz's disease proper, and especially since the etiology is as yet uncertain, it often happens that cases representing allied conditions and thus really belonging to the group of Mikulicz's syndrome (tuberculosis, syphilis and especially the early or aleucemic forms of leukemia) are treated as the true form of Mikulicz's disease. The later course of the lesion, however, will usually correct such an error. In a limited number of cases, the reaction to the treatment (rapid disappearance in pseudoleukemia

and allied conditions, no response in syphilis, etc.) will help to substantiate the diagnosis.

The familial, congenital and hereditary forms of Mikulicz's disease are very rare and are included here only for the purpose of completeness.

Quinke<sup>138</sup> and Külbs<sup>92</sup> reported the occurrence of enlargement of the parotid glands in son, father, two uncles, five brothers and two sisters, each of whom had a "peculiar face." In the son, the enlargement regressed following intercurrent erysipelas, only to return within six weeks after the healing of the infection. Another case of inheritance occurring in two generations was reported by Leri and Gutman<sup>99</sup> and by Laffolley.<sup>96</sup> In the latter's case, the enlargement of the parotid glands was associated with repeated attacks of rheumatism and slight atheroma in both father and son. Nagel<sup>120</sup> observed a symmetrical enlargement of the lacrymal and parotid glands occurring in two brothers.

In certain parts of Africa a condition very similar to Mikulicz's disease occurs which has a definite familial and hereditary tendency. The condition is called "mangy" and consists in the symmetrical enlargement of the parotid glands, the other salivary or the lacrymal glands being only rarely affected. Fontoynt,<sup>52</sup> who made a detailed study of this peculiar disease, was able to collect 90 cases from different parts of Africa and found that in the majority of instances, the familial and hereditary nature could be clearly demonstrated. Furthermore, he found that the disease is confined to certain localities (especially Madagascar), in a manner similar to our "goiter belts", and from this he deduced that it must be the result of a low grade regional infection. The lesion is important since it may be confused with the so-called "forme fruste" of Mikulicz's disease. While we have not had the opportunity of treating a case belonging to this group, the response to radiation according to Astier<sup>8</sup> as a rule is prompt and complete. The

technique of exposure and dose are the same as described for Mikulicz's disease proper.

#### THE MIKULICZ SYNDROME

Under the heading of "the Mikulicz syndrome" we include all those "symmetrical enlargements of the lacrymal and one or more pair of the salivary glands," which are manifestations of some clinically and pathologically well-defined disease.

The most common affections leading to the Mikulicz syndrome are: (1) leucemia; (2) tuberculosis; (3) syphilis; (4) lymphosarcoma and Hodgkin's disease, and (5) uveoparotid fever.

(1) *Leucemia*. The first case of symmetrical enlargement of the lacrymal glands occurring in leucemia was reported by Gallash<sup>60</sup> in 1874, which was fourteen years before Mikulicz first described the condition known by his name. While from a pathological standpoint there was nothing unusual in the appearance of this case, it was described because of the peculiar localization of the leucemia to the lacrymal glands.

With the advent of the theory of the progression of Mikulicz's disease—through pseudoleucemia—to true lymphatic leucemia, several articles appeared in the literature which emphasized the possible enlargement of the lacrymal and salivary glands during the course of lymphatic leucemia (Dunn,<sup>38</sup> Senator,<sup>159</sup> Tileston,<sup>176</sup> Ceconi,<sup>24</sup> and others). Moreover, Howard,<sup>82</sup> Meller,<sup>110</sup> and Schaffer and Jacobsen<sup>155</sup> found that many cases described as pseudoleucemia should have been classified as true lymphatic leucemia, for in many instances careful blood counts were missing, and in others the cases were not observed for a sufficient length of time to form a true opinion as to the exact nature of the disease. Howard<sup>82</sup> cites the cases of v. Brunn,<sup>22</sup> Battle,<sup>16</sup> Stock,<sup>168</sup> Moorhead<sup>117</sup> and Paton<sup>126</sup> as examples of this. According to Howard, the cases were "first and last" chronic lymphatic leucemias, but at the time of the examina-

tion they were in an "aleukemic stage." Indeed, one sees in recent years, with improved laboratory technique and with the more systematic follow-up of the patients observed, a gradual increase in the number of publications dealing with the incidence of the Mikulicz syndrome in all types of leucemias. Hörhammer,<sup>81</sup> Hannema,<sup>71</sup> Abraham,<sup>2</sup> Rivarola,<sup>145</sup> Rodolfo,<sup>146</sup> Satanowsky,<sup>152</sup> Fernández,<sup>48</sup> and especially Schaffer and Jacobsen<sup>155</sup> and Griffith<sup>63</sup> described several cases of acute and chronic lymphatic leucemia, pseudoleucemia and even myeloid leucemia (Hannema<sup>71</sup>), which at certain stages of the disease presented symmetrical involvement of the lacrymal and salivary glands.

The radiation therapy of the Mikulicz syndrome in leucemias should be of a more generalized character than that used in Mikulicz's disease proper. Generally speaking, the procedure and technique of irradiation are the same as for leucemias without the Mikulicz syndrome, except, of course, that the affected salivary and lacrymal glands are also included in the irradiation.

CASE III. (This case is included through the courtesy of Dr. H. A. Freund.) C. O., Male, aged forty-nine, white.

History of Present Illness. The onset of the disease in this patient was rather indefinite. A swelling beneath the angle of the jaw was noticed as far back as 1909, but a swelling of the face did not occur until 1912, at which time there was also enlargement of the superficial lymph nodes of the body.

In 1915, the lacrymal glands started to increase in size, the right more than the left. This resulted in definite protrusion of the eyeballs. Except for some difficulty in swallowing and a loss of 25 pounds in weight, the rest of the history was negative. A satisfactory family history could not be obtained.

Physical Examination 3-16-16. The patient was a moderately well-developed and nourished adult male. In the region of both parotid glands, there was a painless, moderately soft but non-fluctuating swelling, extending well up on the side of the face and downward about the angle of the jaw.



There was symmetrical enlargement of the submaxillary, sublingual and lacrymal glands. There was also bilateral injection of the scleral vessels. The mucous membranes of the mouth were very dry.

There was marked enlargement of the lymph nodes of the left cervical, axillary and inguinal regions. Roentgenograms of the chest showed a shadow about the size of a hen's egg, occupying the region of the left hilus. There was marked enlargement of the spleen and liver, and several tumor masses could be palpated in the abdomen.

**Laboratory Data.** Urinalysis negative. Blood count: red blood cells, 4,500,000; white blood cells, 8,700; polymorphonuclears, 71 per cent; small lymphocytes, 6 per cent; large lymphocytes, 16 per cent; eosinophiles, 2 per cent; basophiles, 3 per cent; transitionals, 2 per cent. Blood Wassermann negative.

**Biopsy Report of Inguinal Lymph Node:** Aleucemic lymphocytoma.

**Course of the Disease.** The patient was hospitalized from March 15, 1916, to May 29, 1916. During this time he received several superficial roentgen treatments administered over the affected salivary glands and some of the lymph glands with satisfactory improvement. On May 18, 1916, the patient suddenly developed pneumonia and died on June 29, 1916.

**Post-mortem Examination.** There was bilateral enlargement of the lacrymal, parotid, submaxillary and sublingual glands.

There was enlargement of the cervical, axillary and inguinal lymph nodes on the left side. The mediastinal lymph nodes formed a mass the size of a cocoanut, occupying the entire mediastinal space. The abdominal lymph nodes were so markedly enlarged that it was impossible to remove the intestines in the ordinary manner. The retroperitoneal lymph nodes were also enlarged.

The spleen was twice its normal size, very soft, and showed localized areas of capsular thickening. The liver was about one-fourth and the pancreas three times larger than the normal size. Both kidneys were diffusely infiltrated with neoplastic tissue.

Microscopically there was a lymphocytic proliferation such as is observed in leucemias.

**Comment.** This case is that of an aleucemic leucemia with symmetrical involvement of the lacrymal, parotid, submaxillary and sublingual glands (Mikulicz's

syndrome). Although the history of the onset of the disease is rather uncertain, it appears nevertheless that the primary manifestations were in connection with the lymphatic system and that the enlargement of the lacrymal and the salivary glands did not develop until later. This, then, indicates that the condition was "first and last" a true leucemia.

**CASE IV.** (This case is included through the courtesy of Dr. R. M. McKean.) Mrs. G. Van T., aged fifty-seven, white.

**History of Present Illness.** In 1926, the patient first noticed a swelling over the right eye which was thought to have subsided following treatment by an ophthalmologist. In December, 1928, she developed a severe diarrhea for which she was treated in another hospital. At that time, during the course of the examination, an enlarged spleen was found and the patient was told that she had "leucemia."

In April, 1929, she noticed that she was becoming "anemic," and rather suddenly developed a generalized edema. In May of the same year, a small firm swelling appeared over the right eye, this being followed soon after by a similar swelling over the left eye, and by enlargement of the submaxillary glands.

From August 10 to August 21 and from September 14 to September 28, 1929, the patient was hospitalized in another institution where she received a series of roentgen treatments. Her blood count at that time (previous to treatment) was as follows: red blood cells, normal; white blood cells, 24,000; polymorphonuclears, 14.5 per cent; large lymphocytes, 75 per cent; small lymphocytes, 5.5 per cent; mononuclears, 3.5 per cent; lymphoblasts, 1 per cent; hb, 51 per cent. Following the roentgen irradiation, there was a rapid decrease in the size of the affected glands and the general condition of the patient showed considerable improvement.

Toward the end of September, 1929, there was recurrence of the swellings and on October 5, 1929, the patient was admitted to Harper Hospital for further irradiation.

The family history revealed that the mother had an "enlarged spleen" and one of her sisters died of pernicious anemia.

**Physical Examination 10-5-29.** The patient was a poorly nourished, adult female, with marked impairment of hearing.

The lacrymal gland of the right eye was enlarged to about the size of an almond; that of the left eye was normal. The pupils and sclerae were negative, the conjunctivae were pale. There was slight enlargement of the parotid glands and a marked enlargement of the submaxillary glands associated with considerable dryness of the mouth.

The posterior cervical lymph nodes were from 1 to 5 cm. in diameter, while the axillary and inguinal lymph nodes were from 1 to 1.5 cm. in diameter. The spleen was markedly enlarged, its lower border extending to just below the level of the umbilicus. The lower liver edge extended to about 2 inches below the costal margin.

There was marked edema of the lower extremities, which no doubt was due to her cardiac condition (chronic myocarditis).

Laboratory Data. Urinalysis negative. Red blood cells, 4,250,000; white blood cells, 24,550; hb, 55 per cent; polymorphonuclears, 31 per cent; large lymphocytes, 67 per cent; transitionals, 2 per cent. Blood chemistry normal. Icteric index 2. Van den Bergh negative in both direct and indirect test. Fragility: Hemolysis began at 0.35 per cent and was complete at 0.25 per cent. Blood Wassermann 4 plus, with cholesterinized antigen and slight inhibition with Kolmer antigen (two examinations).

Diagnosis. Chronic lymphatic leucemia, associated with Mikulicz's syndrome.

Treatment. It was decided to apply the same dose as generally used for chronic lymphatic leucemia.

Because of the condition of the patient, the treatment was administered only over each side of the face and both eyes (520 r, 80 per cent s.v.d., over each field, the quality of the roentgen rays being 0.14 Å). While there was a prompt local response of the treated lesions to the irradiation, the general condition continued to grow worse and the patient died on November 15 before the treatment could be completed.

No post-mortem examination was obtained.

*Comment.* The case is that of a chronic lymphatic leucemia associated with enlargement of the lacrymal and two pairs of the salivary glands (Mikulicz's syndrome). Roentgen therapy, although it led to prompt disappearance of the enlargements in connection with the Mikulicz

syndrome, failed to influence the course of the lymphatic leucemia.

CASE V. T. B., boy, aged three, white.

History of Present Illness. In January, 1926, mother first noticed enlargement of the cervical lymph nodes. Several months later the inguinal lymph nodes were also enlarged and from this



FIG. 5. Symmetrical enlargement of the parotid, submaxillary and lacrymal glands in a case of subacute lymphatic leucemia (Mikulicz's syndrome).

time on the child grew weaker and lost considerable weight. During the summer of 1926 both sides of the face started to swell and a marked dryness of the mouth developed. In October, 1926, the skin became icteric and the temperature frequently rose as high as 103°F. 11-30-26. Patient was admitted to Harper Hospital for treatment.

Physical Examination. The patient was a poorly nourished, very anemic child with an icteric tint to the skin. There was a generalized adenopathy, all superficial lymph nodes being enlarged from 1 to 5 cm. in diameter. There was also enlargement of the lacrymal, parotid and submaxillary glands (Fig. 5). The abdomen was markedly distended, due to enlargement of the spleen and the liver.

Laboratory Data: Blood count: Hb, 60 per cent; red blood cells, 3,620,000; white blood cells, 13,600; polymorphonuclears, 3 per cent;

large lymphocytes, 36 per cent, small lymphocytes, 61 per cent. Blood Wassermann negative.

**Diagnosis.** Subacute lymphatic leucemia, associated with Mikulicz's syndrome.

The patient died shortly after admission so that irradiation could not be carried out.

**Comment.** The case is that of a subacute lymphatic leucemia associated with enlargement of the lacrymal and salivary glands (Mikulicz's syndrome).

(2) *Tuberculosis.* Considerable discussion arose in the literature concerning the influence of tuberculosis on Mikulicz's disease, and its part in the production of the Mikulicz syndrome.

The coincident swelling of the lacrymal and one or more pair of the salivary glands with tuberculous lesions of various parts of the body induced many investigators to consider tuberculosis as a possible cause of Mikulicz's disease.

Meller<sup>110</sup> and Kayser<sup>88</sup> observed the occurrence of symmetrical enlargement of the lacrymal and parotid glands in association with lupus of the nose, while Séjournet<sup>158</sup> found the condition in a case with tuberculous ulcers of the tongue.

The following authors reported the occurrence of Mikulicz's disease in connection with tuberculous lesions of more distant parts of the body: Osler<sup>125</sup> and Fleischer,<sup>51</sup> each in a case of lung tuberculosis (in Osler's case there was also evidence of lues); Ranzi<sup>140</sup> in a case of bone tuberculosis; Plate and Lewandowsky<sup>130</sup> in a case of subcutaneous tuberculosis of the lower extremities; Lüdin<sup>101</sup> in a case of tuberculous pleuritis; Preston and Jeafferson<sup>137</sup> in a case of miliary tuberculosis, etc. In all these instances, however, the microscopic sections of the salivary or lacrymal glands, in those cases in which such sections were made, failed to reveal the presence of tubercle bacilli and, with few exceptions, even the characteristic appearance of tuberculous tissue. This, then, makes the cases valueless as far as their proof of the tuberculous nature of Mikulicz's disease is concerned.

Yet a careful review of the literature reveals that three cases have been published in which a symmetrical enlargement of the lacrymal and salivary glands was due beyond question to tuberculosis. In the first case, that of Plitt,<sup>131</sup> only the lacrymal glands were involved, but the lesion was symmetrical and therefore may be classified as a "forme fruste" of Mikulicz's disease. The tuberculin reaction was positive and the excised glands showed the presence of tubercle bacilli. In the second case, that of Krailsheimer,<sup>90</sup> the symmetrical swelling extended to both the lacrymal and salivary glands and although tubercle bacilli could not be demonstrated, the histologic examination of the extirpated glands showed typical tubercles. The diagnosis in this case was further substantiated by the subsequent development of bilateral tuberculous iridocyclitis and by the fact that the lesion healed promptly following the administration of neotuberculin. The third case (Napp<sup>121</sup>), which is the most conclusive of the three, showed a symmetrical involvement of both lacrymal and parotid glands, complicated by tuberculous nodules of the conjunctivae. The extirpated glands here showed the presence of the tubercle bacillus. Additional cases, in which tubercle bacilli could not be demonstrated, and yet which showed the typical histologic picture of tuberculosis, were reported by Meller,<sup>108</sup> Fleischer,<sup>51</sup> van Duyse,<sup>41</sup> Külbs<sup>92</sup>, and more recently by Marsh<sup>104</sup> and Griffith.<sup>63</sup>

It is of particular interest in this respect that in two outstanding publications, after a detailed review of practically the same cases in the literature, the conclusions were diametrically opposed. Thus the first of the two, the work of Igersheimer and Pöllot,<sup>83</sup> after a survey of more than 55 articles, concludes that tuberculosis is rarely, if ever, a cause of Mikulicz's disease, while the second, the work of Detzel<sup>37</sup> after an analysis of 43 cases, maintains that tuberculosis is a frequent cause of Mikulicz's disease. Without wishing to appear too dogmatic, we, too, believe that



tuberculosis leads to the production of the Mikulicz syndrome more often than hitherto supposed. Thus in our series the association of tuberculosis with the Mikulicz syndrome was demonstrated in two cases. In one of these, the involvement extended to the parotid glands alone, while in the other it involved the submaxillary glands as well.

The radiation therapy of the Mikulicz syndrome occurring in connection with tuberculosis is carried out with the same technique and doses which are used in the treatment of tuberculosis of the lymph nodes.

CASE VI. C. O., Male, aged twenty-two, colored.

History of Present Illness. Since 1921 the patient has been treated in various hospitals for tuberculosis of the lungs, complicated with tuberculous granuloma of the cervical lymph nodes. While his lung condition seemed to remain stationary, the enlargement of the lymph nodes on both sides of the neck progressed gradually. In April, 1924, the enlarged lymph nodes on the right side of the neck were surgically removed. Following this operation, there

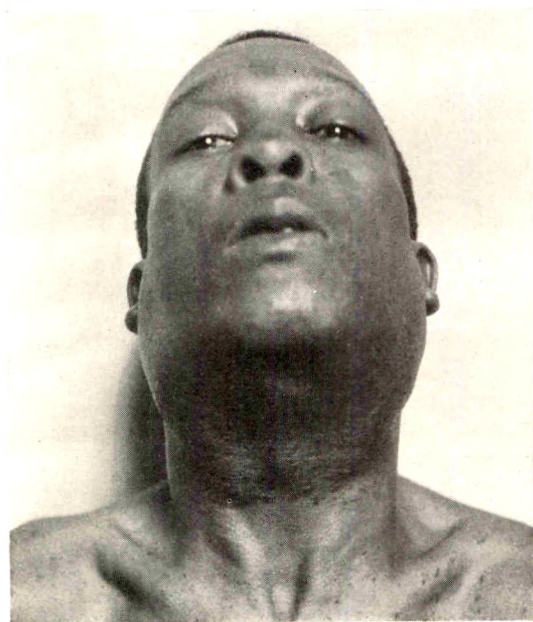


FIG. 6. Symmetrical enlargement of both parotid glands in a case of tuberculous involvement of the lymph nodes of the neck (Mikulicz's syndrome).

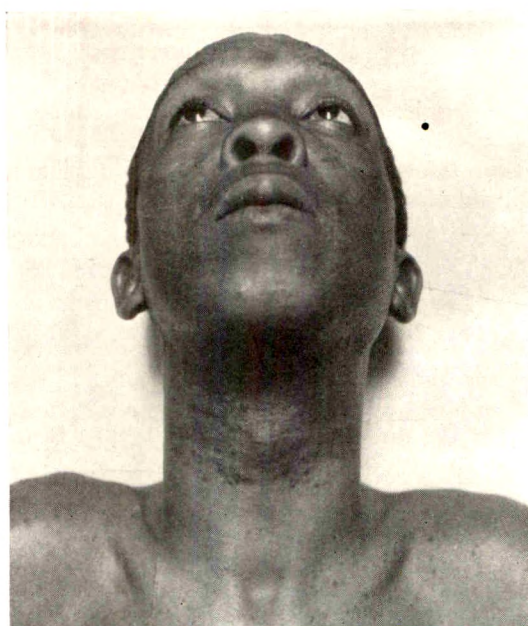


FIG. 7. Same as Figure 6, following roentgen irradiation with fractional doses as practised in tuberculosis.

was a fistula formation which persisted. In January, 1925, a swelling of both sides of the face and neck developed. This later became so pronounced that the patient, because of the marked pressure on the trachea, had difficulty in breathing.

Physical Examination 5-7-25. There was symmetrical enlargement of both parotid glands associated with enormous enlargement of the lymph nodes on both sides of the neck. Practically all of the cervical, submaxillary and supraclavicular lymph nodes were enlarged, some of them being as large as 8 to 10 cm. in diameter (Fig. 6). Posteriorly, on the right side of the neck there was a fistula which drained a greenish-yellow pus. There was no enlargement of the lymph nodes of the rest of the body. The roentgen examination of the chest showed a definite infiltration of the right apex, with bilateral thickening of the apical pleura. The temperature varied from 98 to 101°F. General condition was fair.

Laboratory Data. Urinalysis negative. Blood count: red blood cells, 3,700,000; white blood cells, 19,000; polymorphonuclears, 54 per cent; small lymphocytes, 35 per cent; large lymphocytes, 5 per cent; transitionals, 2 per cent. Blood Wassermann negative.



A lymph node removed for biopsy on May 3, 1925, showed typical tuberculous granuloma.

**Diagnosis.** Large tuberculous lymphadenitis of both sides of the neck, with definite infiltration of the right apex, associated with symmetrical enlargement of both parotid glands (Mikulicz's syndrome).

**Treatment.** Fifteen to 30 per cent S.U.D. over all the enlarged lymph nodes and parotid glands.

5-7-25. One area over each side of face and neck, field  $20 \times 20$  cm., 200 kv., 1 mm. Cu, 1 mm. Al as filters, water-cooled tube, 25 ma., 10 min., 250 ma-min., skin target distance 80 cm, 30 per cent S.U.D. on the surface of the skin, 200 r. The treatment was repeated at intervals of from four to six weeks for a period of over one year.

There was a gradual decrease in the size of the enlarged parotid glands and lymph nodes until practically all lesions had disappeared (Fig. 7).

**Comment.** The case is that of an extensive tuberculosis of the lymph nodes of the neck, associated with symmetrical enlargement of both parotid glands (Mikulicz's syndrome). Following roentgen therapy,

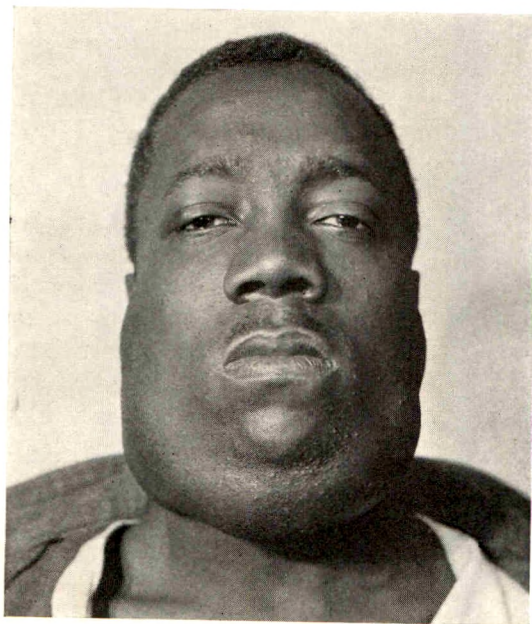


FIG. 8. Symmetrical enlargement of the parotid and submaxillary glands in a case of extensive tuberculosis of the lymph nodes of the neck (Mikulicz's syndrome).

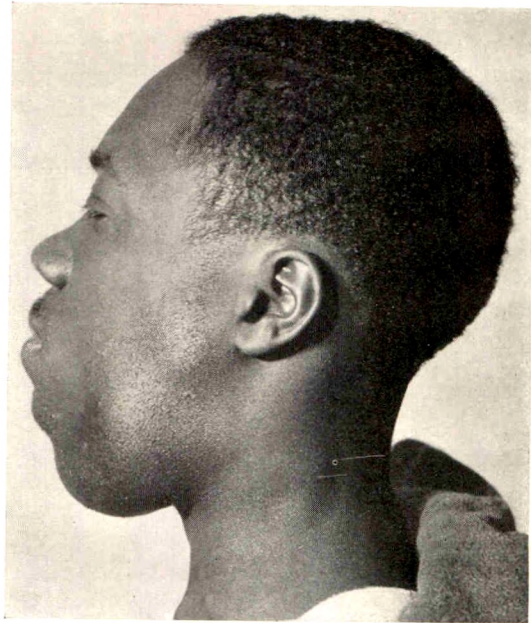


FIG. 9. Same as Figure 8, lateral view.

which extended over a period of a year, a healing of the condition resulted.

**CASE VII.** R. E., Male, aged twenty-one, colored.

**History of Present Illness.** In 1919, the patient noticed a small, pea-sized swelling in the submental region. This later extended to the submaxillary and parotid regions of the face. The development of the process had been slow at first, but during the last two years of the patient's life, it became much more rapid. There was no history of pain, tenderness or suppuration in the glandular enlargements.

Apart from the ordinary diseases of childhood and a Neisserian infection one year previous to his admission, the past history was negative. In 1927, the patient spent nearly a year in a tuberculosis sanitarium, where he was treated by heliotherapy, with only slight improvement. In April, 1929, he was referred to Harper Hospital for radiation therapy.

**Physical Examination 4-9-29.** The patient was a well-developed and nourished colored male. On the right side of the neck in the region of the angle of the jaw, there was a firm tumor mass which extended in a collar-like fashion to the angle of the opposite jaw. The parotid region on each side of the face was likewise occupied by a similar, though smaller tumor, the size of a large walnut (Figs. 8 and 9).

These masses were entirely painless, firm and freely movable. There was no evidence of suppuration or sinus formation. The lacrymal glands were not enlarged.

In addition, there was evidence of tuberculous infiltration of the right upper lobe, with cavitation.

**Laboratory Data.** Urinalysis: albumin, trace; sputum positive for tubercle bacilli. Blood count: Hb, 70 per cent; red blood cells, 4,200,000; white blood cells, 10,000; polymorphonuclears, 77 per cent; lymphocytes, 20 per cent; transitionals, 3 per cent. Kahn and Wassermann tests, 4 plus.

**Diagnosis.** Tuberculous lymphadenitis with infiltration and cavitation of the right upper lobe associated with symmetrical enlargement of the parotid and submaxillary glands (Mikulicz's syndrome).

**Treatment.** Fifteen per cent skin unit dose over each side of face and neck, field 20 × 20 cm., 200 kv., 1 mm. Cu, 1 mm. Al as filters, water-cooled Coolidge tube, 20 ma., 5 min., 100 ma-min., 65 cm. skin target distance, 100 r.

The treatment was repeated at intervals of from two to four weeks for eight exposures. At that time the affected glands were reduced to about one-half the original size.

In the meantime, the tuberculosis of the lung progressed rather rapidly so that in August, 1929, the patient had to be hospitalized (in another institution) and October 13, 1929, he died.

**Comment.** The case is that of an extensive tuberculosis of the lymph nodes and lungs, associated with bilateral involvement of the parotid and submaxillary glands (Mikulicz's syndrome). Roentgen therapy led to reduction in the size of the lesion treated, with temporary improvement in the condition of the patient. The rate of reduction in the size of the treated glands corresponded to that generally observed in tuberculosis. The patient died later as a result of the complicating lung affection.

(3) *Syphilis.* That syphilis may be an etiologic factor in Mikulicz's disease was first brought out by Osler.<sup>125</sup> In his case, a colored girl aged eleven, there was a symmetrical enlargement of the lacrymal and salivary glands associated with syphilitic

rhinitis and pulmonary tuberculosis. From the post-mortem findings, it was not clear which of the two played the more important part in bringing about the Mikulicz syndrome. A combination of lues and tuberculosis was also observed in the cases of Lintz<sup>100</sup> and Posey.<sup>135</sup>

The possible occurrence of a symmetrical swelling of the lacrymal and especially of the salivary glands in syphilis was demonstrated by Gutmann,<sup>65</sup> Vennin and Worms,<sup>178</sup> Theodoresco,<sup>173</sup> Nagel,<sup>120</sup> de Massary and Tockmann,<sup>105</sup> Jeanselme,<sup>86</sup> Comby,<sup>29</sup> Sabrazès,<sup>149</sup> Bourges,<sup>20</sup> Bazàn and Maggi,<sup>17</sup> and more recently by Jeanselme, Huet and Desbrousses.<sup>86</sup> Moscovici<sup>118</sup> in 1919 wrote a monograph on the subject.

In some of the above cases, as in those of Gutmann, de Massary and Tockmann, Comby and Moscovici, a disappearance of the Mikulicz syndrome resulted following antiluetic treatment.

We did not have the opportunity to treat or observe a case in which syphilis could be definitely shown to be the etiologic factor in the production of the Mikulicz symptom-complex, although in two of our cases (Cases IV and VII), the Wassermann reaction was positive. We believe that in such instances antileuetic treatment rather than radiation therapy would be the method of choice.

(4) *Lymphosarcoma and Hodgkin's Disease.* A relation between lymphosarcoma and Mikulicz's disease was suspected early. Some of the very first cases described in which the swelling of the lacrymal and salivary glands was associated with involvement of the entire lymphatic system (Adler<sup>3</sup> and Axenfeld<sup>11</sup>) served as proofs of the lymphosarcomatous nature of Mikulicz's disease. Wallenfäng,<sup>180</sup> in 1904, after finding in one of his cases that the lymphocytic infiltration had broken through the capsule of the lymph nodes, ventured the statement that "the tumefactions of Mikulicz's disease do not belong to the pure aleukemic leukemias, but approach the commonly known malignant lymphosarcomas."

Shortly afterward, Caspary,<sup>23</sup> Meller,<sup>110</sup> Ziegler<sup>188</sup> and Pooley<sup>132</sup> reported additional cases in which the swelling of either the lacrimal or the salivary glands alone, or of both, was due to more or less typical lymphosarcomatous proliferations. With the advent of the theory of the "syndrome" nature of certain forms of "Mikulicz's disease," however, it became apparent that such proliferations must represent secondary localizations of the lymphosarcomatous process rather than true Mikulicz's disease on a lymphosarcomatous basis. Recent publications of Fernández,<sup>48</sup> Hardesty,<sup>72</sup> and Schaffer and Jacobsen,<sup>155</sup> also emphasized this "syndrome" nature of lymphosarcomas involving the lacrimal and salivary glands.

The method of irradiation in such instances must be the same as that used for lymphosarcoma in general,<sup>45</sup> that is, the entire lymphatic system must be exposed to radiation and a dose applied which is considerably larger than that used in Mikulicz's disease proper.

CASE VIII. Mrs. W. D., aged fifty-seven, white.

History of Present Illness. In June, 1929, the patient noticed excessive lacrymation, followed soon afterward by the appearance of a small, painless swelling in the upper lid of the left eye. A few months later, a similar swelling occurred in the right upper eyelid.

In October, 1929, the tumor of the left eyelid was removed. The pathological report was that of a small, round cell lymphosarcoma.

The past history was entirely negative.

11-20-29, the patient was admitted to Harper Hospital for radiation therapy.

Physical Examination 11-20-29. The patient was a well-developed, well-nourished adult female.

There was a partial ptosis of both eyelids and a tumor 2.5 cm. in diameter over the right eye in the region of the lacrimal gland. In the region of the left lacrimal gland, there was a small scar representing the site of the former operation. Both conjunctivae were injected and there was some induration and a tendency to entropion of the eyelids.

There was definite enlargement of the pre-

auricular, postauricular and submaxillary lymph nodes on both sides, giving a "Mikulicz facies." There was also enlargement of the cervical, supraclavicular and axillary lymph nodes on the right side. The spleen and liver were of normal size.

Laboratory Data. Urinalysis negative. Blood count: Hb, 100 per cent; red blood cells, 4,230,000; white blood cells, 8,200; polymorphonuclears, 66 per cent; lymphocytes, 20 per cent; transitionals, 10 per cent; eosinophiles, 4 per cent. Blood Wassermann negative. Blood chemistry normal.

Diagnosis. Generalized small round cell lymphosarcoma associated with involvement of both lacrimal glands (Mikulicz's syndrome).

Treatment. Ninety per cent S.U.D. (590 r) over the entire lymphatic system including both lacrimal glands and both sides of the face. The treatment was spread over a period of ten days (Nov. 20 to Nov. 30, 1929), one to two areas having been exposed daily. The total number of areas treated was fourteen.

Following the irradiation there was a "melting away" of all tumors, such as is generally observed in lymphosarcomas. The enlarged lacrimal glands assumed their normal appearance and all symptoms in connection with the eyes disappeared.

The general condition of the patient at the present time is satisfactory.

Comment. The case is that of a rather generalized, small round cell lymphosarcoma, with a symmetrical extension of the process to both lacrimal glands (Mikulicz's syndrome). Following administration of roentgen therapy, all tumors "melted away" and the eye symptoms disappeared.

The occurrence of the Mikulicz syndrome in Hodgkin's disease is comparatively rare. In a detailed survey of the literature, we were able to find only a few instances in which reference is made to the possibility of association of these two conditions (Ziegler,<sup>188</sup> Minelli,<sup>115</sup> and McDonald and War-dale<sup>106</sup>).

We have observed one case in which Hodgkin's disease led to a symmetrical involvement of both parotid glands, resulting in a "Mikulicz facies."



CASE IX. Mr. G. A., aged fifty-six, white.

History of Present Illness. In August, 1928, the patient noticed a small firm tumor in the right supraclavicular fossa, which gradually increased in size. At the end of three months, similar tumor masses were noted in both cervical and postauricular areas. The sides of the face were likewise somewhat involved in the process. Later enlargement of the lymph nodes appeared in the submental, submaxillary, axillary and inguinal regions.

The above described tumor masses were never painful and had never suppurated.

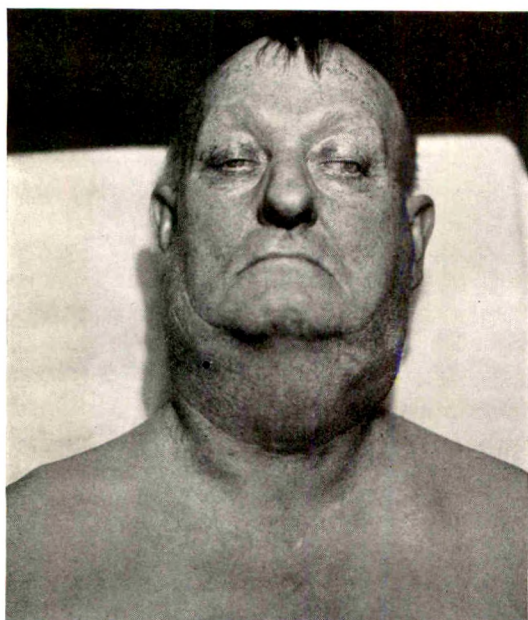


FIG. 10. Symmetrical enlargement of both parotid glands in a case of Hodgkin's disease (Mikulicz's syndrome).

During the course of his illness, the patient lost about 30 lbs. in weight, and complained of marked fatigability.

The past history was negative except for an injury to the left eye about twenty years previously, resulting in a partial loss of the vision of the eye.

At another institution, on Jan. 17, 1930, a section was taken from the left side of the face and eight days later, one from the right side of the face. The microscopic report in both instances was Hodgkin's disease.

On Feb. 6, 1930, the patient was transferred to the Harper Hospital for radiation therapy.

Physical Examination 2-6-30. The patient

was a well developed and well-nourished male.

There was a marked swelling of both sides of the neck and face due to enormous enlargement of the cervical, submaxillary, submental and pre- and postauricular lymph nodes. The lesion also invaded both parotid glands (Fig. 10), resulting in marked dryness of the mouth.

The left eye presented a rather large leucoma at the site of the previous injury, with a divergent strabismus. The lacrimal glands were normal.

There was enlargement of the supraclavicular, axillary and inguinal lymph nodes on both sides, from 1 to 5 cm. in diameter.

The spleen and liver were of normal size.

Laboratory Data. Urinalysis negative. Blood count: Hb, 60 per cent; red blood cells, 3,360,000; white blood cells, 9,750; polymorphonuclears, 87 per cent; large lymphocytes, 9 per cent; transitionals, 4 per cent. Blood Wassermann negative; blood nitrogen negative.

Diagnosis. Hodgkin's disease, associated with symmetrical enlargement of both parotid glands (Mikulicz's syndrome).

Treatment. The entire lymphatic system, as well as the enlarged parotid glands, was irradiated with doses of 90 per cent S.U.D. (590 r) over the individual fields. The rate of response to the radiation was that usually observed in Hodgkin's disease. The patient is still under treatment.

Comment. The case is that of a rather generalized Hodgkin's disease with marked swelling of both sides of the neck and face, due to involvement of the cervical, submaxillary, submental, and pre- and postauricular lymph nodes, as well as of the parotid glands (Mikulicz's syndrome). Following roentgen therapy, there was decided improvement in the condition of the patient.

(5) *Uveoparotid Fever*. In 1909, Heerfordt<sup>75</sup> described a condition which he called "febris uveoparotidea subchronica" and which he considered an atypical manifestation of epidemic parotitis.

The three cases observed by Heerfordt—and a few others collected from the literature—which served as a basis for the description of the disease, presented: (1) fever, which was only slight and of long duration; (2) iridocyclitis, occasionally



complicated with optic neuritis; (3) parotitis, in some instances associated with involvement of other salivary and the lacrymal glands, and (4) paresis of one or several cerebrospinal nerves. It is obvious that there is a great similarity between this symptom-complex and Mikulicz's disease. For this reason several investigators classified febris uveoparotidea subchronica as a form of the Mikulicz syndrome.

Following the initial publication of Heerfordt, numerous other articles describing similar conditions appeared in the literature. By 1924, Berg<sup>18</sup> had collected 40 cases, from a survey of which he concluded that febris uveoparotidea subchronica was merely a syndrome which might be the result of tuberculosis (Gjesing,<sup>61</sup> Michaelsson,<sup>112</sup> Heine,<sup>76</sup> and Critchley and Phillips<sup>33</sup>), syphilis, atypical mumps (Weve<sup>182</sup>), or that it may represent a subvariety of Mikulicz's disease. A similar opinion was expressed by Hamburger and Schaffer,<sup>70</sup> who recently made a very detailed investigation of all questions pertaining to this condition.

There were only two cases of uveoparotid fever recorded in the literature which were treated by radiation therapy. The first, that of Jackson,<sup>84</sup> had enlargement of the parotid glands associated with a bilateral iridocyclitis and a partial facial paralysis. The irradiation of the eyes and parotid glands (five treatments at weekly intervals with 4 ma., 125 kv., 10 in. distance, 5 min., 5 mm. Al filter) resulted in permanent healing.

The second case, that of Hamburger and Schaffer,<sup>70</sup> likewise showed enlargement of the parotid glands, with bilateral iridocyclitis except that here the eye manifestations were early. Three radium applications were made under the direction of Burnam and Kelly, the dose being as follows: 2 gm-hr. irradiation screened with 1 mm. brass and 1 mm. lead at a distance of 5 cm. (first for the right parotid alone, 6 days later for the left parotid alone, and again 15 days later for both parotids simultaneously). The result of the irradiation

was striking: within a few weeks there was entire disappearance of the swelling of the parotid glands and the iridocyclitis disappeared rapidly. A re-examination five years later revealed that the condition had healed permanently. The only evidence of the previous iridocyclitis was a few corneal deposits and the fine vitreous opacities.

We have not had an opportunity to observe a case of uveoparotid fever. For a while there was some doubt in our minds with regard to the classification of our first case, but because of the long duration and the localization of the eye lesions to the cornea alone, we did not feel justified in including this case as an example of uveoparotid fever.

#### CONCLUSIONS

On the basis of a study of nine cases, we believe that "the symmetrical enlargements of the lacrymal and one or more pair of the salivary glands," originally described as Mikulicz's disease, should be divided into two main groups: Mikulicz's disease proper and the Mikulicz syndrome.

Under Mikulicz's disease proper are included all cases of symmetrical, non-inflammatory swellings of the lacrymal and salivary glands without involvement of the lymphatic system and without alteration of the blood.

Under the Mikulicz syndrome are included the cases in which the enlargements of the lacrymal and salivary glands are manifestations of some clinically and pathologically well-defined disease, such as leucemia, tuberculosis, syphilis, lymphosarcoma, Hodgkin's disease, uveoparotid fever, etc.

In the first group, the technique of the radiation therapy is based on the principle that there is a lymphocytic infiltration with an organized structural arrangement, so-called "lymphadenosis," of the affected lacrymal and salivary glands. This implies that divided doses (15 to 50 per cent s.u.d.) spread over a longer period are more beneficial than the one single massive dose as

administered in neoplastic processes. For the same reason, the quality of the rays used is of considerably less importance.

In the second group, since the involvement of the lacrymal and salivary glands is merely a manifestation of a more or less distinct clinical entity, a technique should be used which conforms to the routine procedure of irradiation applied in that particular entity.

It has been repeatedly suggested that Mikulicz's disease proper be considered an

"aleucemic stage" of leucemia. There are two reasons why this should not be done: First, the average life duration is considerably longer in Mikulicz's disease than in either the acute or chronic forms of leucemia; second, the radiosensitivity of the lymphocytic infiltration, because of its organized structural arrangements in Mikulicz's disease, is definitely less than in the more malignant, and consequently less differentiated lymphocytic proliferations in leucemias.

## REFERENCES

1. ABADIE, CH. Tumeurs rares symétriques des paupières. *Arch. d'ophth.*, 1881, 1, 432-437.
2. ABRAHAM, A. Eigenartiger Fall von Mikulicz'scher Krankheit. *Med. Klin.*, 1926, 22, 594; 1759-1761.
3. ADLER. Sitzungsbericht d. Ges. d. Ärzte in Wien. *Wien. med. Wchnschr.*, 1889, 2, 422.
4. APERT, E. Infantilisme et hypertrophie des glandes salivaires. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1908, 25, 155-157.
5. ARNOLD, J., and BECKER, O. Doppelsitiges symmetrisch gelegenes Lymphadenom der Orbita. *Arch. f. Ophth.*, 1872, 18, 2, 56-58.
6. ARNST, J. Über zwei Fälle von Mikulicz'scher Erkrankung. 1913, Grewert and Majert, Marburg, 30 p. Thesis.
7. ASKEY, S. G. A case of Mikulicz's disease. *Lancet*, 1920, 2, 502.
8. ASTIER, A. Hypertrophie symétrique des glandes parotides traitée par la radiothérapie. Guérison. *Bull. et mém. Soc. de radiol. méd. de France*, 1929, 17, 201-205.
9. ATKINSON, J. A case of Mikulicz's disease. *Proc. Roy. Soc. Med.*, 1912-13, 6 (*Laryngol. Sect.*), 1.
10. AUBINEAU, E. Un cas de "maladie de Mikulicz." *Ann. d'ocul.*, 1912, 147, 422-425.
11. AXENFELD, TH. Zur Lymphombildung in der Orbita. *Arch. f. Ophth.*, 1891, 37, 3, 102-124.
12. BAAS. Ein Fall von symmetrischen Geschwülsten der Tränendrüse, der Lider, von Mund- (und Schlund?) Schleimhaut- (auch Kehlkopf-) Drüsen. *Ztschr. f. Augenh.*, 1903, 10, 184-188.
13. BARBICK, J. F. "Mikulicz's disease"; clinical report of a case with presentation of the patient. *Calif. Eclect. M. J.*, 1915, 8, 187-190.
14. BARJON, and LACOUR. Un cas de maladie de Mikulicz. *Soc. nat. de méd. de Lyon*, 3 mai, 1909. Cited Vallery-Radot, Pasteur, etc., *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1927, 51, 416.
15. BARTLETT, E. Mikulicz's disease. *Surg. Clin. N. Am.*, 1923, 3, 823-829.
16. BATTLE, W. H. A case of Mikulicz's disease. *Proc. Roy. Soc. Med.*, 1911-1912, 5 (*Clin. Sect.*), 171-174.
17. BAZÁN, F., and MAGGI, R. Consideraciones sobre el síndrome de Mikulicz. Descripción de un caso clínico; parotiditis crónica bilateral en un disendocrínico heredo-luetico. *Arch. latino-am. de pediat.*, 1925, 19, 843-853, also *Semana méd.*, 1925, 32, 1, 1214-1218.
18. BERG, F. Über "Febris uveo-parotidea" (Heerfordt). *Hygiea*, 1923, 85, 401-420. Ref. *Zentralbl. f. Ophth.*, 1924, 13, 254.
19. BERTHON, G. Contribution à l'étude du Syndrome de Mikulicz. Thèse de Paris, 1911.
20. BOURGES, H. A propos de deux cas de syndrome de Mikulicz et de leur interprétation pathogénique. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1924, 48, 854-859.
21. BROECKAERT, J. Pseudoleucémie simulant la prétendue maladie de Mikulicz. *Rev. gén. d'ophth.*, 1907, 238.
22. v. BRUNN, M. Die symmetrische Schwellung der Thränen- und Mundspeicheldrüsen in ihren Beziehungen zur Pseudoleukämie. *Beitr. z. klin. Chir.*, 1905, 45, 225-279.
23. CASPARY. Demonstration i. Ver. f. wissenschaftl. Heilkunde, Königsberg i. Pr. Ref. *Deutsche med. Wchnschr.*, 1905, 31, 444.
24. CECONI, A. La malattia di Mikulicz nei suoi rapporti con la leucemia e la pseudoleucemia. *Riforma med.*, 1913, 29, 449; 477.
25. CHEINISSE, L. La maladie de Mikulicz. *Semaine méd.*, 1905, 25, 37-39.
26. CHUITON, and AUBINEAU. Erfolg der Röntgen- und Radiumtherapie in einem Falle von Mikulicz'scher Krankheit. *Strahlentherapie*, 1914, 4, 636-639.
27. CLARKE, J. M. A case of Erb's juvenile dys-trophy associated with bilateral enlargement of the parotid and submaxillary glands. *Brain*, 1903, 26, 202-205.

28. COGOLLI, L. Morbo di Mikulicz pseudo-leucemico curato colla radioterapia. *Radiol. med.*, 1921, 9, 215-217.
29. COMBY, J. La maladie de Mikulicz. *Arch. de méd. d. Enfants*, 1922, 25, 41-46. Ref. *J. Am. M. Ass.*, 1922, 78, 763.
30. CONCETTI, L. Sulla produzione sottolinguale dell'infanzia. Commun. al II. Congr. Ped. italiano tenuto in Napoli nell'ottobre 1892. Cited Reinbach, G. Zur Lehre von den sublingualen Geschwülsten des Kindesalters. *Beitr. z. klin. Chir.*, 1897, 18, 451.
31. COOPER, P. R. A case of Mikulicz's disease (symmetrical enlargement of the lacrymal and salivary glands). *Clin. J. London*, 1921, 50, 758.
32. COURCHET. Un cas grave de maladie de Mikulicz. *Rev. de stomatol.*, 1927, 29, 756-760.
33. CRITCHLEY, McD., and PHILLIPS, P. A case of uveo-parotitic paralysis. *Lancet*, 1924, 906-907.
34. CUTLER, C. W. Symmetrical enlargement of parotid and lacrimal glands. Nodular iritis. *Tr. Am. Ophth. Soc.*, 1904, 10, 390-397.
35. DANIEL, C. C. Contribución al estudio del síndrome de Mikulicz. *Rev. de especialidad, Buenos Aires*, 1926, 1, 251-262.
36. DEBIERRE. Un cas de tuméfaction symétrique des glandes lacrymales et parotidiennes. *Rev. gén. d'ophth.*, 1893, 12, 433-437.
37. DETZEL, L. Ein Beitrag zur Beziehung der Mikulicz'schen Erkrankung zur Tuberkulose der Tränendrüsen. *Klin. Monatsbl. f. Augenh.*, 1917, 59, 381-413.
38. DUNN, J. A case of bilateral, slow, painless hypertrophy of the lachrymal, parotid, submaxillary, and sublingual glands, accompanied by marked and prolonged general symptoms. *Ophth., N. Y.*, 1907, 36, 52-58.
39. DUNN, Th. D. A case of leukemia with rare lymphoid growths of orbits and parotid glands. *Tr. Coll. Phys., Phila.*, 1893, 15, 103-109.
40. DURANTI, L. Sulla cura del morbo di Mikulicz. Atti del I. Congr. italiano di Radiologia medica (1913), Pavia, 1914, 1, 219. Ref. *Strahlentherapie*, 1916, Refer. Bd. I., 435-436.
41. v. DUYSE. Contribution à l'étude des tumeurs symétriques lymphomateuses pseudoleucémiques des glandes lacrymales et salivaires. *Arch. d'ophth.*, 1905, 25, 705-717.
42. EGERTON, G. B. A case of Mikulicz's disease. *Brit. M. J.*, 1926, 2, 686.
43. ELLIOT, R. N., and INGRAM, A. C. Maladie de Mikulicz. *Clin. ophth.*, 1911, 17, 248-251.
44. EVANS, J. J. A case of Mikulicz's disease. *Birmingham M. Rev.*, 1911, 70, 80-87.
45. EVANS, Wm. A., and LEUCUTIA, T. Roentgen-ray treatment of lesions of the lymphoid tissue. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1927, 17, 54-90.
46. EWING, J. Tissue reactions to radiation. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1926, 15, 93-115.
47. FAURE, J. L. Sur le Mikulicz. *Medecine*, 1923-24, 5, 524-526.
48. FERNÁNDEZ, J. G., CARRI, M. A., and CHAIT, E. Consideraciones sobre un caso de Mikulicz con sarcoma de mediastino y leucemia. *Semana méd.*, 1925, 32, 1299-1307; also *Prensa méd. argen.*, 1925-26, 12, 491.
49. FISHER, C. Mikulicz's disease. *Journal-Lancet*, 1914, 34, 159-161.
50. FITTIG, O. Röntgenbehandlung eines Falles von symmetrischer Erkrankung der Parotis. *Allg. med. Centralztg.*, 1904, No. 31, 606.
51. FLEISCHER, B. Ein Fall von eigentümlicher symmetrischer Tränen- und Ohrspeicheldrüsenschwellung mit Erkrankung der Konjunktiva. *Klin. Monatsbl. f. Augenh.*, 1902, 40, 398; cited Fleischer, B., *Klin. Monatsbl. f. Augenh.*, 1910, 48, 290.
- FLEISCHER, B. Diskussion zur Demonstration eines Falles von Mikulicz'scher Erkrankung mit ausgesprochener Iristuberkulose. *Ophth. Klin.*, 1907, 11, 393.
- FLEISCHER, B. Beziehungen der Mikulicz'schen Krankheit zur Tuberkulose und Pseudoleukämie. *Klin. Monatsbl. f. Augenh.*, 1910, 48, 289-312.
52. FONTOYNOT, M. Le mangy. *Presse méd.*, 1911, 19, 455-459.
53. FORMIGGINI, B. Contributo alla casistica della sindrome di Mikulicz. *Gazz. med. lomb.*, 85, 73-76.
54. FRANKE. Mikulicz'sche Krankheit. *Deutsche med. Wchnschr.*, 1918, 44, 187.
55. FRENKEL, H. Sur le syndrome de Mikulicz à l'état physiologique. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1912, 34, 578-581; also *Arch. d'ophth.*, 1912, 32, 721-725.
56. FREUND. Mit Röntgenstrahlen behandelter Fall von Mikulicz'scher Krankheit. *Deutsche med. Wchnschr.*, 1907, 33, 1560.
57. FRIDERICIA, L. S. A case of Mikulicz's disease. *Ugeskr. f. Laeger.*, 1917, 79, 341; also *Bibliot. f. Laeger.*, 1917, 109, 39-46.
58. FROMOWICZ, W. Das Problem der Mikulicz'schen Krankheit und deren Behandlung. *Centralbl. f. d. Grenzgeb. d. Med. u. Chir.*, 1912-13, 16, 548-578.
59. FUCHS, E. Gleichzeitige Erkrankung der Tränendrüsen und der Parotiden. (Mikulicz'sche Krankheit). *Beitr. z. Augenh.*, 1891, 1, 208; also *Wien. med. Presse*, 1891, 1954.
60. GALLASCH, F. Ein seltener Befund bei Leukämie im Kindesalter. *Jahrb. f. Kinderh.*, 1874, 7, 82-88.
61. GJESSING, H. Ueber Tuberkulose als Aetiologie

- bei der sog. Febris uveo-parotidea (Heerfordt). *Klin. Monatsbl. f. Augenh.*, 1918, 60, 249-252.
62. GOUGET. Forme incomplete de la maladie de Mikulicz. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1910, 29, 796.
  63. GRIFFITH, J. P. CROZER. Mikulicz's disease and the Mikulicz syndrome. *Am. J. M. Sc.*, 1929, 178, 853-860.
  64. GUILLAIN, G., KUDELSKI, C., and LIEUTAUD, P. Syndrome de Mikulicz apparu au cours d'une encéphalite épidémique. *Bull. Acad. de méd.*, 1922, 88, 80-84.
  65. GUTMANN, A. Mikulicz'sche Krankheit in ihrer Beziehung zur Lues. *Klin. Wchnschr.*, 1907, 44, 1141-1143.
  66. HAECKEL, H. Beitrag zur Kenntniss der symmetrischen Erkrankung der Thränen und Mundspeicheldrüsen. *Arch. f. klin. Chir.*, 1903, 69, 191-203.
  67. HAENISCH, F. Fall von symmetrischer Erkrankung der Thränen- und Mundspeicheldrüsen (Mikulicz-Kümmel) mit "Heilung" durch Röntgenstrahlen. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1906, 10, 291-295.
  68. HAGENBACH, E. Symmetrische Lymphangiome der Mundspeicheldrüsen. *Deutsche Ztschr. f. Chir.*, 1908, 93, 478-493.
  69. HALTENHOFF. Hyperplasie lymphatique des glandes lacrymales et salivaires. *Ann. d'ocul.*, 1889, 102, 110-114.
  70. HAMBURGER, L. P., and SCHAEFFER, A. J. Uveo-parotid fever as a manifestation of Mikulicz's Syndrome. *Am. J. Dis. Child.*, 1928, 36, 434-444.
  71. HANNEMA, L. S. Aleukemic myelosis with clinical picture of Mikulicz's disease. *Folia haematol.*, 1926, 32, 116-124.
  72. HARDESTY, J. F. Mikulicz's disease. *Am. J. Ophth.*, 1926, 9, 655-658.
  73. HARMEL. Ein Fall von Mikulicz'scher Krankheit. *Deutsche med. Wchnschr.*, 1909, 35, 1616-1617.
  74. v. HASE, W. Der Mikulicz'sche Symptomenkomplex. Breitkopf and Hartel, Leipzig, 1912.
  75. HEERFORDT, C. F. Ueber eine "Febris uveo-parotidea subchronica" an der Glandula parotis und der Uvea des Auges lokalisiert und häufig mit Paresen cerebros spinaler Nerven kompliziert. *Arch. f. Ophth.*, 1909, 70, 254-273.
  76. HEINE, L. Über Augenerkrankungen beim Mikulicz'scher Symptomenkomplex. *Arch. f. Augenh.*, 1925, 97, 101-119.
  77. HEMPELMANN, L. H. Mikulicz's disease. *Med. Clin. N. Am.*, 1924, 7, 1663-1668.
  78. HIJMAN VAN DEN BERGH, A. A. Symmetrical hypertrophy of the parotid glands (Mikulicz). *Nederl. Tijdschr. v. Geneesk.*, 1915, 1, 175-178.
  79. HIRSCH, C. Ein weiterer Beitrag zur Lehre von der symmetrischen Erkrankung der Tränen- und Mundspeicheldrüsen (Mikulicz). *Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 1898, 3, 381-393.
  80. HOFMEISTER. 77 Vers. deutsch. Naturf. und Ärzte zu Meran. 1905. Ref. *Zentralbl. f. Chir.*, 1905, 32, 1358.
  81. HÖRHAMMER. Demonstration von Pat. mit Mikulicz'scher Erkrankung. *Strahlentherapie*, 1919, 9, 455-456; also *München. med. Wchnschr.*, 1918, 65, 393; 432.
  82. HOWARD, C. P. Mikulicz's disease and allied conditions. *Internat. Clin.*, 1909, 1, 30-63.
  83. IGERSEIMER, J., and PÖLLOT, W. Über die Beziehungen der Mikulicz'schen Krankheit zur Tuberkulose und über den Infektionsweg bei der tuberkulösen Erkrankung der Tränendrüse. *Arch. f. Ophth.*, 1910, 74, 411-466.
  84. JACKSON, B. H. Use of x-ray in uveoparotitis. *Am. J. Ophth.*, 1925, 8, 361-363.
  85. JAYLE, F. Hypertrophie de la glande parotide et parotidite chronique. *Presse méd.*, 1894, 174; also *Bull. Soc. anat. de Par.*, 1894, 120.
  86. JEANSELME. Syndrome de Mikulicz et syphilis. *Médecine*, 1921, 3, 100-101.
  - JEANSELME, E., HUET, L., and DESBROUSSES. Syndrome de Mikulicz chez un syphilitique tertiaire. *Bull. Soc. franç. de dermat. et syphil.*, 1928, 35, 20-22.
  87. DE JONG, S. I., and JOSEPH, H. Un cas fruste de syndrome de Mikulicz chez un infantile. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1908, 25, 140-144.
  88. KAYSER. Über einen Fall von Mikulicz'scher Krankheit. *Klin. Monatsbl. f. Augenh.*, 1907, 45, 118-119.
  89. KOETTNITZ, A. Ueber symmetrisches Auftreten von Lipomen. *Deutsche Ztschr. f. Chir.*, 1893, 38, 75-123.
  90. KRAILSHEIMER, A. Mikulicz'sche Erkrankung mit ausgesprochener Irismetuberkulose. *Ophth. Klin.*, 1907, 11, 449-455; also *Klin. Monatsbl. f. Augenh.*, 1907, 45, 118.
  - KRAILSHEIMER, A. A case of Mikulicz's disease with pronounced tubercle of the iris. *Ophthalmoscope*, 1908, 6, 172-177.
  91. KRAUSE, P. Zur Röntgentherapie der "Pseudo-leukämie" und anderweitiger Bluterkrankungen. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1905, 9, 152-175 (see p. 174).
  92. KÜLBS. Über Mikulicz'sche Krankheit. *Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 1908, 18, 754-761.
  93. KÜMMEL, W. Weitere Beiträge zur Lehre von der symmetrischen Erkrankung der Tränen- und Mundspeicheldrüsen (Mikulicz). *Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 1897, 2, 111-141.



94. KÜTTNER, H. Ueber entzündliche Tumoren der Submaxillarspeicheldrüse. *Beitr. z. klin. Chir.*, 1896, 15, 815-828.
- KÜTTNER. Die symmetrische Erkrankung der Tränen- und Mundspeicheldrüsen (Mikulicz'sche Krankheit). *Berl. klin. Wchnschr.*, 1921, 58, 980.
95. LACOUS. Maladie de Mikulicz. *Lyon méd.*, 1909, 112, 1106-1109.
96. LAFFOLLEY, P. De l'hypertrophie simple des glandes parotides. Thèse de Paris, 1894.
97. LANE, LAURA C. A study of tumors of the lacrimal gland with report of a mixed tumor. *Am. J. Ophth.*, 1922, 5, 425-434.
98. DE LAPERSONNE, F. Tuberculose probable de la glarde lacrymale. *Arch. d'ophth.*, 1892, 12, 211.
99. LERI, A., and GUTMAN. Hypertrophie simple, congénitale, familiale, héréditaire et régionale des diverses glandes salivaires (mangy algérien?). *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1912, 34, 368-370.
100. LINTZ, W. Von Mikulicz's disease. *N. York State J. M.*, 1911, 11, 67-76.
- LINTZ, W. Von Mikulicz's disease; further studies. *J. Am. M. Ass.*, 1913, 61, 1621-1623.
101. LÜDIN, M. Über die Mikulicz'sche Krankheit und ihre Behandlung mit Röntgenstrahlen. *Cor.-Bl. f. schweiz. Aerzte*, 1915, 45, 1014; also *Strahlentherapie*, 1916, 7, 360-370.
102. MARCOTTY. Symmetrische aleukämische Lymphadenome der Lider und Orbita, geheilt durch Strahlentherapie. *Deutsche med. Wchnschr.*, 1921, 47, 1015.
- MARCOTTY, A. H. Doppelseitige, symmetrische aleukämische Lymphadenome der Orbita und der Tränendrüsen und ihre Heilung durch Strahlentherapie. *Klin. Monatsbl. f. Augenh.*, 1922, 68, 166-175.
103. MARCUSE, P. Ein Fall von Mikulicz'scher Krankheit (symmetrische Anschwellung der Tränen- und Mundspeicheldrüsen). *Berl. klin. Wchnschr.*, 1904, 41, 1205.
104. MARSH, PHIL. L. Atypical tuberculosis with Mikulicz's Syndrome: Report of a case, with unusual pulmonary and subcutaneous lesions. *Am. J. M. Sc.*, 1921, 161, 731-740.
105. DE MASSARY, E., and TOCKMANN, L. Syndrome de Mikulicz à début rapide, simulant les oreillons, chez un syphilitique. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1918, 42, 627-629.
- DE MASSARY, E., and TOCKMANN, L. Syndrome de Mikulicz de nature syphilitique, guéri par le traitement mixte. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1918, 42, 987.
106. McDONALD, S., and WARDAL, J. D. Note on a case of Mikulicz's disease. *J. Path. & Bacteriol.*, 1912-13, 17, 113-114.
107. McKENZIE, D. Mikulicz's disease. *Lancet*, 1920, 2, 574-575.
108. MELLER. Symmetrischer Tumor der Tränendrüsen und Krauseschen Drüsen. *Ztschr. f. Augenh.*, 1904, 12, 796-797.
109. MELLER, J. Ueber die Beziehungen der Mikulicz'schen Erkrankung zu den lymphomatösen und chronisch-entzündlichen Processen. *Klin. Monatsbl. f. Augenh.*, 1906, 44, 176-201.
110. MELLER, J. Weitere Mitteil. über lymphoide Geschwulstbildungen in den Thränendrüsen und Orbita mit besonderer Berücksichtigung des Lymphosarkoms. *Klin. Monatsbl. f. Augenh.*, 1907, 45, 491-509.
111. MÉRY, H., GIRARD, L., and MERCIER-DESROCHETTES. Maladie de Mikulicz avec état de sympathicotonie et syndrome polyglandulaire fruste. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1921, 45, 406-412.
112. MICHAELSSON, E. A case of uveoparotid fever (Heerfordt). *Hygiea, Stockholm*, 1924, 86, 344-348.
113. MIDDELDORPF, and MOSES, S. Ein Fall von Mikulicz'scher Krankheit. *Deutsche med. Wchnschr.*, 1909, 35, 1479-1481.
114. MIKULICZ, J. Sitzung des Vereines f. wissenschaftliche Heilkunde zu Königsberg i. Pr. Jan., 23, 1888. *Berl. klin. Wchnschr.*, 1888, 25, 759.
- MIKULICZ, J. Ueber eine eigenartige symmetrische Erkrankung der Tränen- und Mundspeicheldrüsen. *Beitr. z. Chir., Festschrift f. Theodor Billroth, Stuttgart*, 1892, 610-630.
115. MINELLI, SPARTACO. Beitrag zum Studium der Lymphomatose der Speichel- und Tränendrüsen. *Virchow's Arch. f. path. Anat. (etc.)*, 1906, 185, 117-132.
116. MOHR. Ueber die innere Sekretion der Speicheldrüsen und ihre Beziehungen zu den Genitalorganen. *Ztschr. f. Geburtsh. u. Gynäk.*, 1913, 75, 408-433.
117. MOORHEAD, T. G. An unusual case of Mikulicz's disease. *Dublin J. M. Sc.*, 1922, 595-597.
118. MOSCOVICI, MOISE. Syndrôme de Mikulicz de nature syphilitique. Thèse de Paris, 1919.
119. MUNCK, W. Ein Beitrag zur Beleuchtung des Mikulicz'schen Symptomenkomplexes. *Virchow's Arch. f. path. Anat. (etc.)*, 1925, 256, 81-85.
120. NAGEL, J. Die klinische Bedeutung doppelseitiger chronischer Speichel- und Tränendrüsenanschwellungen (Mikulicz'scher Symptomenkomplex). *Ztschr. f. klin. Med.*, 1916, 83, 358-380.
121. NAPP, O. Über die Beziehungen der Mikulicz'schen Erkrankung zur Tuberkulose. *Ztschr. f. Augenh.*, 1907, 17, 513-517.
122. NEW, GORDON B. Bilateral parotid tumors. *Mayo Clinic Collected Papers*, 1915, 7, 43-51.

123. NOLAN, M. J. Mikulicz's disease associated with dementia precox. *Irish J. M. Sc.*, 1928, 223-227.
124. OLSHO, S. L. A case of von Mikulicz's disease. *Laryngoscope*, 1916, 26, 918-921.
125. OSLER, WM. On chronic symmetrical enlargement of the salivary and lachrymal glands. *Am. J. M. Sc.*, 1898, 115, 27-30.
126. PATON, L. Case of Mikulicz's disease. *Proc. Roy. Soc. Med.*, 1914-15, 8 (*Ophth. Sect.*), 28-31.
127. PFEIFFER. Über die Röntgentherapie der symmetrischen Tränen- und Speicheldrüsen-erkrankung. *Beitr. z. klin. Chir.*, 1906, 50, 245-261.
128. PICK, L. Beiträge zu den Thränen-drüsentumoren. *Centralbl. f. Augenh.*, 1896, 97.
129. PINCH, A. E. HAYWARD. Two cases of Mikulicz's disease treated with radium. *Brit. M. J.*, 1926, 2, 586-587.
130. PLATE, E., and LEWANDOWSKY, F. Ueber einen Fall von symmetrischer Schwellung der Speichel- und Tränen-drüsen, nebst Beteiligung des lymphatischen Apparates und der Haut. *Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 1913, 25, 539-548.
131. PLITT, W. Ueber Tuberkulose der Tränen-drüsen. *Klin. Monatsbl. f. Augenh.*, 1905, 43, 40-63.
132. POOLEY, G. H. Case of Mikulicz's Disease. *Proc. Roy. Soc. Med.*, 1915-16, 9 (*Ophth. Sect.*), 100-102.
133. POPP, L. Efectul tratamentului cu raze Röntgen asupra boalei Mikulicz Kümmel. *Cluj. med.*, 1928, 9, 457-460.
134. PORTMAN, G. Syndrome de sclérose des glandes de la face. *J. de méd. de Bordeaux*, 1920, 91, 403; Abst. *J. Am. M. Ass.*, 1920, 75, 1164.
135. POSEY, WM. C. Bilateral enlargement of the lacrymal glands. *Ophth. Rec.*, 1900, 240.  
POSEY, WM. C. Notes on a case of symmetrical lymphomata of the lacrymal and salivary glands (Mikulicz's Disease). *Ophth. Rec.*, 1916, 25, 286-289; also *Tr. Coll. Phys. Phila.*, 1916, 38, 345.
136. POWER. Hypertrophy of right lacrymal gland; left removed for same condition. *Tr. Ophth. Soc. United Kingdom*, 1886-87, 7, 109.
137. PRESTON, T. W., and JEAFFRESON, B. L. Mikulicz's disease associated with arrested miliary tuberculosis. *Brit. M. J.*, 1925, 1, 304-305.
138. QUINKE. Über die Mikulicz'sche Erkrankung. *München. med. Wchnschr.*, 1906, 53, 47.
139. RADCLIFFE, MCC. A case of Mikulicz's disease. *Tr. Coll. Phys. Phila.*, 1923, 45, 332-334.
140. RANZI, E. Ueber einen mit Röntgenstrahlen bestrahlten Fall von Mikulicz'scher Krankheit. *Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 1906, 16, 554-561; also *Centralbl. f. Chir.*, 1905, 32, 1357-1358.
141. RAYBAUD, A. Un cas de syndrome de Mikulicz. *Marseille méd.*, 1921, 58, 113-127; 1088.
142. REINBACH, G. Zur Lehre von den sublingualen Geschwülsten des Kindesalters. *Beitr. z. klin. Chir.*, 1897, 18, 451-460.
143. v. REUSS. Doppelseitige chronische Tränen-drüsen-schwellung. *Ztschr. f. Augenh.*, 1906, 15, 572-573.
144. REYMOND, C. Linfomi voluminosi delle due orbite ed al davanti delle due orecchi con degenerazione amiloidea dei soli elementi linfoidi. *Ann. di ottalmol.*, 1883, 12, 337.
145. RIVAROLA, R. A. Enfermedad de Mikulicz en un niño de seis años. *Semana méd.*, 1919, 26, 552.
146. RODOLFO, A. Sobre un caso de enfermedad de Mikulicz. *Semana méd.*, 1919, 26, 124.
147. ROMME, R. La maladie de Mikulicz. *Presse méd.*, 1908, 16, 269.
148. ROSS, J. A., and SHEPHEARD-WALWYN. A case of Mikulicz's disease. *Tr. Ophth. Soc. United Kingdom*, 1923, 43, 332-340.
149. SABRAZÈS, J. Syndrome fruste de maladie de Mikulicz avec tarissement de la sécrétion salivaire chez un spécifique. *Gaz. hebdom. d. sc. méd. de Bordeaux*, 1923, 44, 460-462.
150. SAMAJA, N. Mikulicz's disease. *Bull. d. sc. méd., Bologna*, 1920; Abst. *Lancet*, 1920, 2, 660-661.
151. SARDA. Hypertrophie physiologique des glandes salivaires et lacrymales; syndrome de Mikulicz physiologique. Thèse de Toulouse, 1912.
152. SATANOWSKY, P. Sobre un caso de leucemia linfática y enfermedad de Mikulicz. *Rev. Assoc. méd. argent.*, 1921, 34, 1275-1284.
153. SAUSSOL, J. Des diverses formes cliniques de la maladie de Mikulicz. Thèse de Paris, 1910.
154. SCALES, J. L. Bilateral tumors of the lacrymal and parotid glands: Mikulicz syndrome. *Tr. Am. Acad. Ophth. & Otolaryng.*, 1922, 27, 149-162.
155. SCHAEFFER, A. J., and JACOBSEN, A. W. Mikulicz's syndrome. A report of 10 cases. *Am. J. Dis. Child.*, 1927, 34, 327-346.
156. SCHMIDT, H. Beitrag zur Auffassung der Mikulicz'schen Krankheit. *Folia haematol.*, 1920, 25, 71-106.
157. SCHMIDT, R. Mikulicz'sche Krankheit; Paralysis agitans sine agitatione. *Med. Klin.*, 1918, 14, 405.
158. SÉJOURNET. Sur l'hypertrophie chronique et simultanée des glandes lacrimales et salivaires. *Rev. de chir.*, 1910, 42, 85.
159. SENATOR. Mikulicz'sche Krankheit, lymphatische Leukämie und Chlorom. *Deutsche med. Wchnschr.*, 1907, 33, 1353.
160. SHOEMAKER, W. I. A case of bilateral enlarge-

- ment of the lacrymal glands. *Ann. Ophth.*, 1904, 13, 513-519.
161. SICARD. Maladie de Mikulicz à forme fruste et avec absence de sécrétion salivaire. *Semaine méd.*, 1912, 322.
  162. SICARD, J. A., and LEBLANC, A. Syndrome de Mikulicz avec absence de sécrétion salivaire. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1912, 33, 960.
  163. SIMON. Die Röntgenbestrahlung des Morbus Mikulicz. *Mitt. a. d. Aug. d. Carolin. medikochirurg. Inst. z. Stockholm*, 1909, No. 10, 109.
  164. SMITH, J. F., and BUMP, W. S. Lymphoid hyperplasia of lacrymal and salivary glands; Mikulicz's disease. *Ann. Surg.*, 1928, 88, 91-97.
  165. SNEGIREFF, K. W. Ueber doppelseitige gleichzeitige Erkrankung der Tränen- und Speicheldrüsen. *Klin. Monatsbl. f. Augenh.*, 1906, 44, Beilageheft, 142-159.
  166. SNELL, S. Simultaneous and symmetrical tumors of the lacrymal and parotid glands. *Lancet*, 1893, 2, 26.
  167. SOUQUES, A., and CHÉNÉ, H. Forme atypique de la maladie de Mikulicz. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1909, 26, 340-344.
  168. STOCK, W. Ueber Augenveränderungen bei Leukämie und Pseudoleukämie. *Klin. Monatsbl. f. Augenh.*, 1906, 44, 328-352.
  169. STOEWER. Ein Beitrag zur Pathologie der Thränendrüse. *München. med. Wchnschr.*, 1901, 48, 177-180.
  170. STOPPATO, U. Le syndrome de Mikulicz. *Riv. ospedal.*, 1920, 10, 47-54.
  171. TASCHENBERG, E. W. Mikulicz'scher Symptomenkomplex und innere Sekretion. *München. med. Wchnschr.*, 1921, 68, 333.
  172. THAYSEN HESS, TH. E. Über die Lymphomatosen der Tränen- und Speicheldrüsen. *Beitr. z. path. Anat. u. allg. Path.*, 1911, 50, 487-531.
  173. THEODORESCO, P. Maladie de Mikulicz et syphilis avec une observation personnelle. *Ann. d. mal. vén.*, 1914, 9, 801; 881.
  174. THURSFIELD, H. Bilateral salivary swellings (Mikulicz's disease). A clinical review. *Quart. J. Med.*, 1913-14, 7, 237-249.
  175. TIETZE, A. Ein Beitrag zur Lehre von der symmetrischen Erkrankung der Tränen- und Speicheldrüsen. *Beitr. z. klin. Chir.*, 1896, 16, 816-832.
  176. TILESTON, W. A discussion of Mikulicz's disease with report of a case of lymphatic leucemia in a child with marked enlargement of the salivary glands. *Am. J. Dis. Child.*, 1911, 2, 293-301; also *Tr. Am. Ped. Soc.*, 1911, 23, 356-365.
  177. VALLERY-RADOT, PASTEUR, GIBERT, P., BLAMOUTIER, P., and WEYLAND J. Radiothérapie et pilocarpine dans le traitement de deux cas de syndrome de Mikulicz avec hypocrinie salivaire. *Bull. et mém. Soc. méd. d. hôp. de Par.*, 1927, 51, 410-418.
  178. VENNIN, and WORMS. Hypertrophie symétrique des glandes salivaires et lacrymales (maladie de Mikulicz) d'origine syphilitique. *Bull. Soc. de méd. mil. franç.*, 1914, 8, 468-472.
  179. VOIT. Mikulicz'sche Krankheit. *Deutsche med. Wchnschr.*, 1909, 35, 86.
  180. WALLENFANG. Beitrag zur Lehre von der symmetrischen Erkrankung der Tränen- und Speicheldrüsen. *Virchow's Arch. f. path. Anat. (etc.)*, 1904, 176, 90-102.
  181. DE WECKER, L., and MASSELOU, J. Tumeurs symétriques des glandes lacrymales, palpébrales et des parotides. *Arch. d'ophth.*, 1892, 12, 65-70.
  182. WEVE, H. Drei Fälle von Parotitis epidemica mit Iridozyklitis. *Arch. f. Augenh.*, 1919, 85, 202-221.
  183. WEVE, H. Familial Pseudotuberculosis. (Mikulicz-Heerfordt disease). *Nederl. Tijdschr. v. Geneesk.*, 1926, 70, 2187-2189.
  184. WEISSBACH, E. Ein Fall von Mikulicz'scher Krankheit, forme fruste. *Mitt. d. Gesellsch. f. inn. Med. u. Kinderh. in Wien*, 1922, 21, 66.
  185. WOOD, C. G. R. Mikulicz's disease complicated by Graves' disease. *Tr. Ophth. Soc. United Kingdom*, 1928, 48, 398-401.
  186. WRIGHT, R. E. Mikulicz disease treated by x-ray. *Am. J. Ophth.*, 1927, 10, 903-905.
  187. ZIEGLER, J. Zur Röntgenbehandlung der Mikulicz'schen Krankheit. *Strahlentherapie*, 1926, 23, 528-531.
  188. ZIEGLER, S. L. Mikulicz's Disease. *Ophth. Rec.*, 1905, 14, 245.
  - ZIEGLER, S. L. Bilateral lymphomata of the lacrymal, parotid and submaxillary glands due to tonsillar hypertrophy and subsequent oxidation. *Ann. Ophth.*, 1906, 15, 72-75.
  - ZIEGLER, S. L. Symmetrical lymphomata of the lacrimal and salivary glands (Mikulicz's disease). *Tr. Am. Ophth. Soc.*, 1909, 12, 222-245; also *J. N. York M. Ass.*, 1909, 90, 1159-1166.
  189. ZIRM, E. Ein Fall von gleichzeitiger chronischer Tränendrüse- und Parotidenschwellung. Vorübergehende Heilung durch interkurrierendes Erysipel. *Wien. med. Presse*, 1891, 1954; also *Beitr. z. Augenh.*, 1892, 1, 314.

## UNUSUAL CHOLECYSTOGRAMS AND THEIR INTERPRETATION\*†

By A. J. DELARIO, M.D.

*Research Assistant in Surgery, Cornell University Medical College*

NEW YORK CITY

THERE are several theories concerning the function of the gall-bladder which may be grouped into two fundamental divisions, depending upon whether the cystic duct is considered a one-way or a two-way passage. Sweet<sup>13,15</sup> Halpert,<sup>7,8</sup> Demel and Brummelkamp<sup>4</sup> and Blond,<sup>1</sup> believe that the cystic duct is a one-way tube. Sweet, who first announced this theory, believes that whatever enters the gall-bladder leaves normally only by absorption.<sup>14</sup>

One of the most important reasons for this point of view is based upon an extensive study of the valve arrangement of the cystic duct, and its tortuosity. The valves are there for some reason, yet they do not prevent the bile from entering the gall-bladder. After the gall-bladder has concentrated the bile ten times at least, it would be ten times as hard for this bile to leave the gall-bladder, on the basis of viscosity alone, even if there were no valves.

Winkelstein,<sup>17,18</sup> Graham,<sup>5,6</sup> McMaster and Elman,<sup>12</sup> Higgins and Mann,<sup>9</sup> Whitaker,<sup>16</sup> Boyden,<sup>3</sup> Boyden and Birch,<sup>2</sup> and Ivy and Oldberg,<sup>11</sup> believe that the cystic duct is a two-way duct, bile entering and leaving by the same channel. Winkelstein believes that bile leaves the gall-bladder through the force of the respiratory movements. Graham thinks the incoming bile forces that already in the gall-bladder to leave. The others believe that the gall-bladder squeezes bile out by muscular activity in its own wall.

The purpose of this paper is to show some unusual roentgenograms following the Graham test, and to see which theory best explains the gall-bladder function in that particular set of roentgenograms. If

a theory is to stand it must explain the unusual cases as well as the normal cases.

The visualization shown in the accompanying roentgenograms followed the routine oral administration of the dye. At the twelfth hour, the gall-bladder is visualized. At the sixteenth hour the gall-bladder shadow ordinarily decreases slightly in size, but increases in density. At the seventeenth hour the shadow usually decreases greatly in size and may disappear.

Sweet explains these changes on the basis of absorption as follows: At the sixteenth hour the shadow becomes slightly smaller and denser because the dye is being absorbed (causing the shadow to grow smaller), at the same time water is absorbed faster than the dye (causing the shadow to become denser). After a fat meal the gall-bladder shadow diminishes greatly in size because, first, fat stimulates liver secretion and opens the papilla of Vater (thus causing this increased dye secretion to enter the intestine rather than the gall-bladder). Second, fat and fatty acids precipitate the dye, rendering it insoluble and not absorbable (so that it cannot be reabsorbed from the intestine to eventually maintain the shadow in the gall-bladder). Higgins and Wilhelmj<sup>10</sup> have recently shown that whatever action the fat might have, is exerted in the intestine, for intravenous injection of fat has no effect on the emptying of the gall-bladder. Finally, fat may possibly stimulate gall-bladder absorption.

Now, does the giving of a high fat meal add in any way to the interpretation of the case, or is it really a disadvantage because it throws a burden of added expense upon the patient? We have obtained all the knowledge we can about the condition of

\* From the Department of Surgical Research, Cornell University Medical College, and from the Cornell Clinic, New York City.

† This work was aided by a gift from Mrs. John L. Given in support of surgical research.



the gall-bladder with the twelve hour roentgenogram alone. The very fact that the gall-bladder fills indicates that the cystic duct is open, and that the gall-bladder is able to empty itself by some means or other, for unless it were doing so, no dye-containing bile could have entered.

The roentgenologist would bring up the fact that some dye shadows do not contract after a fat meal, and might say that these gall-bladders are pathological, and have been found in a state of chronic in-

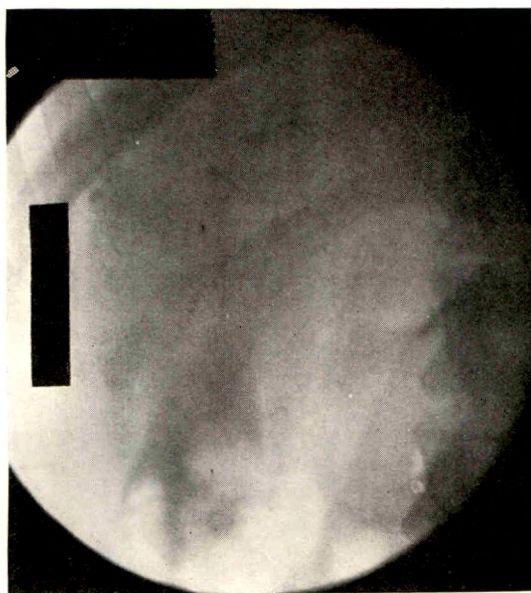


FIG. 1a. A gall-bladder filling with dye at the twelve hour examination.

flammation by the pathologist. However, this may be the very group of cases not benefited by the operation of cholecystectomy, because it is more likely that the papilla of Vater did not open so as to allow fat to act on the dye coming from the liver rather than that any real pathology actually existed in the gall-bladder.

Those who believe in the dilution theory explain the sixteen hour roentgenograms by saying that the less concentrated bile and dye on entering the gall-bladder goes to the periphery. Some of the more concentrated bile and dye is thus expelled through the cystic duct. The fat meal,



FIG. 1b. A gall-bladder concentrating the dye at the sixteen hour examination.

causing increased liver secretion, merely accentuates this phenomenon. However, when liver secretion is increased and the papilla of Vater opens, most authorities agree that bile enters the duodenum and

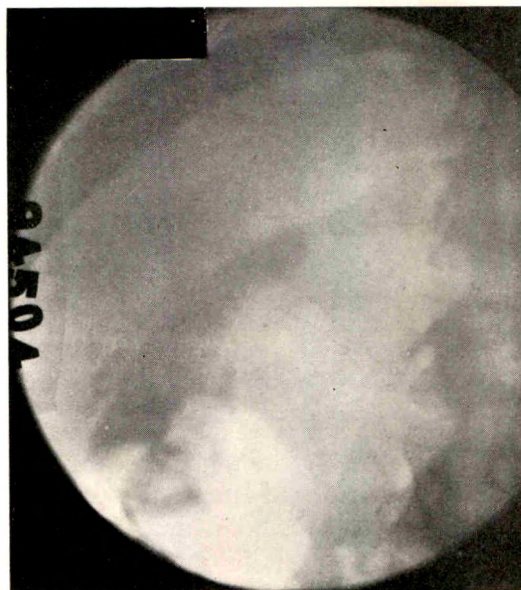


FIG. 1c. A gall-bladder shadow which is fainter but of the same size at the seventeen hour examination.



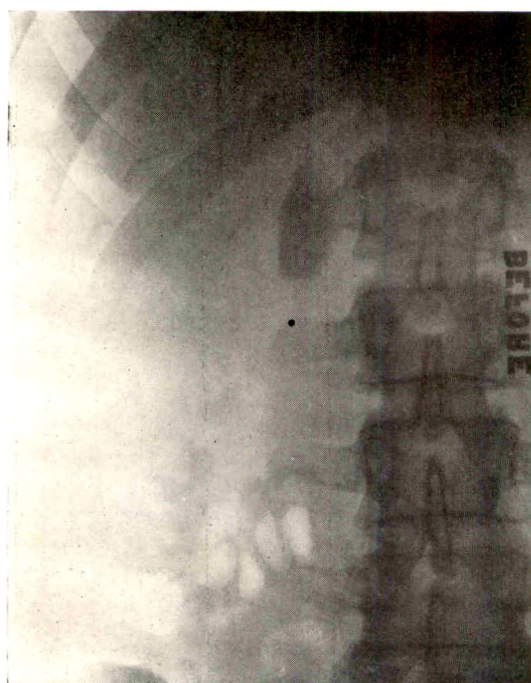


FIG. 2a. Cholecystogram before a high fat meal.

not the gall-bladder. The increased density seen at the sixteenth hour must nevertheless be explained by the water absorption taking place at that time.

Even those who feel that the gall-bladder forces its contents out through the cystic duct must grant an absorptive and concentrating power to the gall-bladder in order to explain the roentgenograms at the sixteenth hour.

Figures 1a, 1b and 1c show a gall-bladder filling at the twelfth hour, concentrating at the sixteenth hour, decreasing in density at the seventeenth hour, yet the size of the gall-bladder remains unchanged. This is what normally takes place in the dog's gall-bladder. It could be explained as follows: At the sixteenth hour the dye is concentrated by the absorption of some of the water and still less of the dye. At the seventeenth hour, following a fat meal, absorption of the dye is taking place, but no contraction of the dye shadow occurs because diffusion of the dye throughout the entire gall-bladder is taking place as fast as absorption occurs. Thus the dye density

decreases uniformly throughout, instead of of at the periphery where it does normally. In the normal gall-bladder, bile is thick and the dye is held in greater attraction. The thick bile at the center of the gall-bladder permits of a slower diffusion of the dye particles, while there is rapid absorption at the periphery. In this manner the shadow contracts in size. In a dog's gall-bladder the bile is thin, as a rule, and the dye is diffused as fast as absorption takes place, and therefore there is no contraction of the shadow. The shadow will disappear without materially changing in size. So here we have a case where diffusion and absorption is similar to that found in a dog's gall-bladder.

Those who believe in the dilution theory assume that at the seventeenth hour the less concentrated mixture of bile and dye coming from the liver, forced some of the more concentrated mixture out of the gall-bladder, and as a result there was a uniform diffusion, causing the density of the shadow to decrease. But how can they

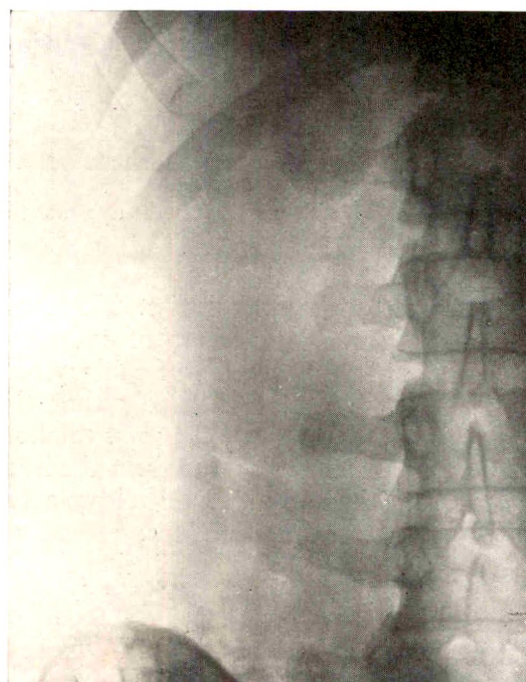


FIG. 2b. The dye shadow grows larger and less dense after a fat meal.



explain the increased concentration at the sixteen hour examination?

Exponents of the contraction theory would state that we have a pathological case. Normal function is not taking place because the gall-bladder is pathological. Absorption must play a part, however, because the shadow at sixteen hours has increased in density while not changing in size. A disease process which has destroyed the muscular coat and not the mucosa, would have to be present.

Figures 2*a* and 2*b* show the shadow of the gall-bladder which became much larger after a fat meal. How are the exponents of the theory of contraction to explain this? They must again predicate a pathological state, which was probably not present, since a repetition of the test showed the gall-bladder to function well. Possibly a temporary closure of the papilla of Vater has backed up the increased liver secretion following the high fat meal.

Figure 2*b* shows the gall-bladder shadow to be much larger, and the density greatly decreased, after the fat meal. Is this possible because the incoming bile has diluted



FIG. 3*a*. Cholecystogram before a fat meal in a jaundiced patient.

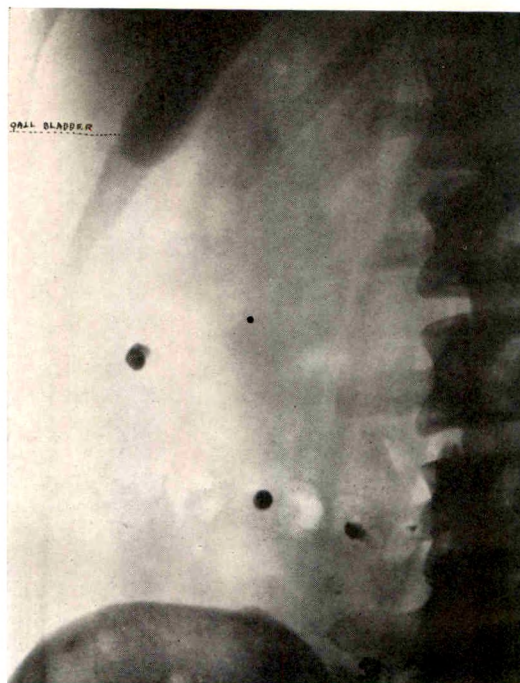


FIG. 3*b*. Contraction of the dye shadow after a high fat meal. Patient was jaundiced.

the already concentrated bile? The gall-bladder became larger because it could not absorb as fast as the liver secreted to it.

Figures 3*a* and 3*b* show an apparently normal gall-bladder shadow with normal function, although the patient was jaundiced. One can readily see how this might take place if the gall-bladder function is purely one of absorption. It would be hard to explain this on the basis of contraction. To do this it would have to contract against the greatly increased pressure in the biliary system.

Figures 4*a* and 4*b* show stones apparently pushed up by the gall-bladder contraction after a fat meal. This seems to offer the strongest argument for the contraction theory. Sweet offers three explanations: (1) The gall-bladder may absorb its fluid content. When this takes place the stones are rearranged because of the elasticity of the gall-bladder wall. (2) Variation in the specific gravity of the bile may cause the stones to rise or fall, changing their positions and giving rise to the impression



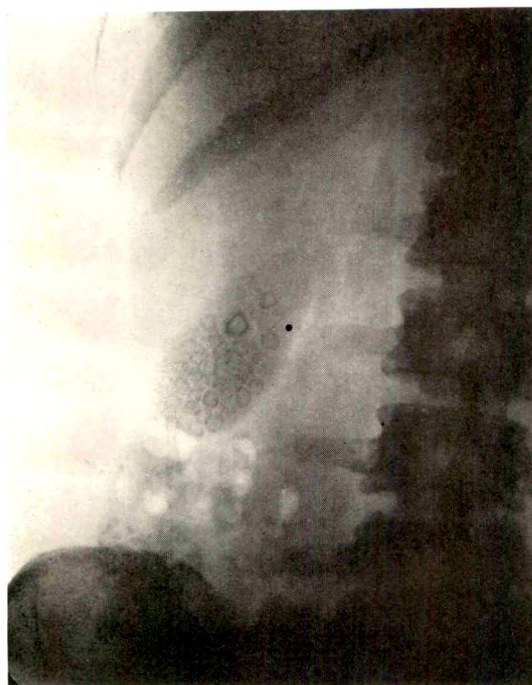


FIG. 4a. A gall-bladder filled with dye and stones.

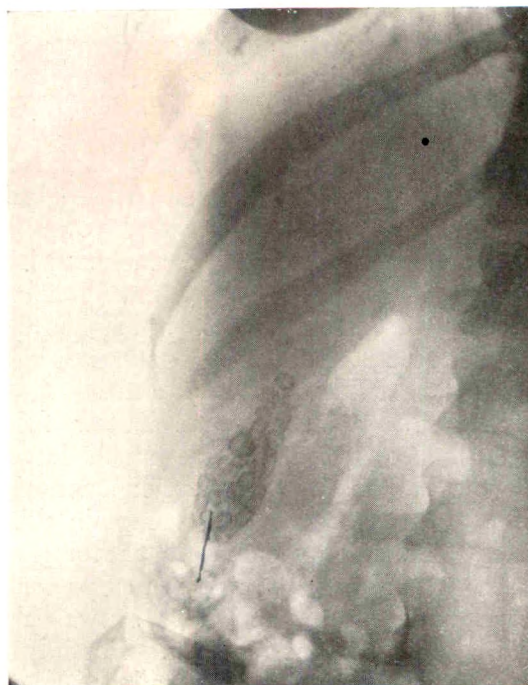


FIG. 4b. After a high fat meal, the stones are re-arranged.

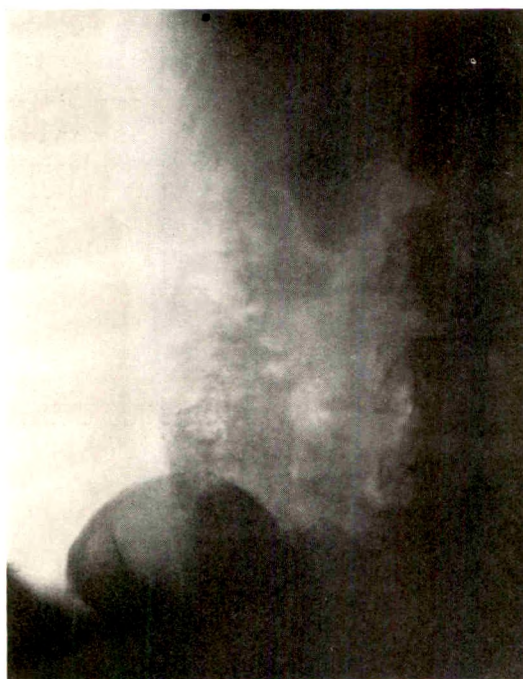


FIG. 5a. Dye shadow before a high fat meal.

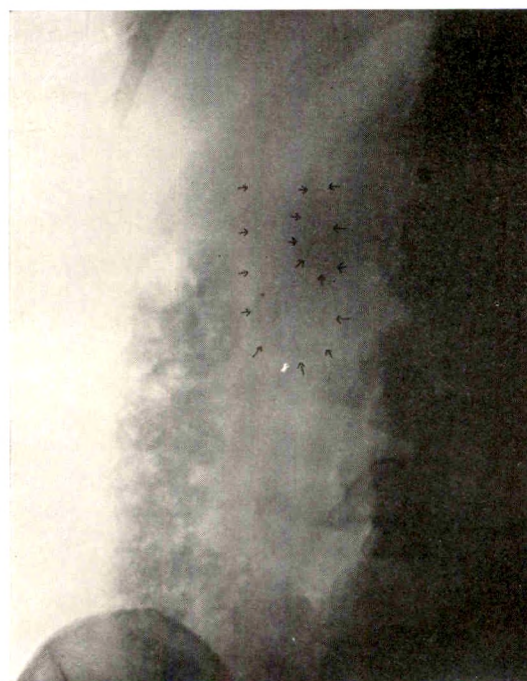


FIG. 5b. Two dye shadows are seen in the gall-bladder after a high fat meal: a dense shadow in the upper right-hand corner and a light shadow surrounding this. The outer edge of the light shadow may mark the boundary of the gall-bladder mucosa.



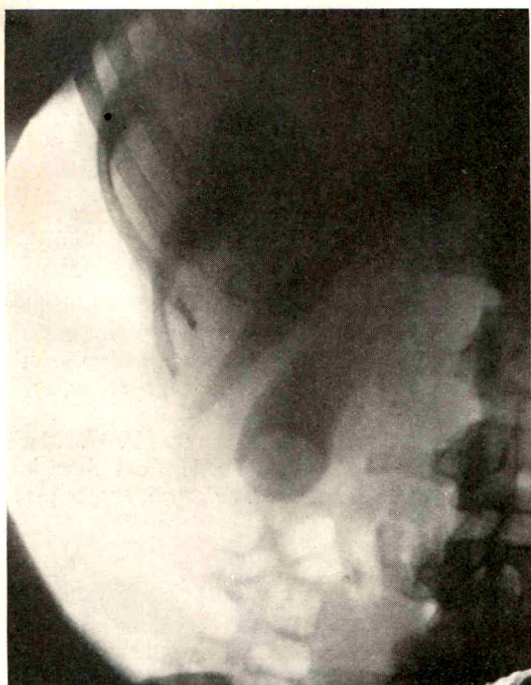


FIG. 6a. Dye shadow before a fat meal.

of contraction. It should be remembered that human gall-bladder bile is more often a thin jelly than a watery solution. A colloid condition exists which must influence the movement of dye molecules and the relation of larger masses, such as stones, contained within the gall-bladder. Sometimes a faint shadow of relatively decreased density may be seen about the periphery of the dense shadow. The exact cause of this is unknown. It may be that it represents a shell of bile from which the dye has been absorbed by the neighboring mucosa. This is difficult to reproduce, but can be seen fairly well in Figures 5a and 5b.

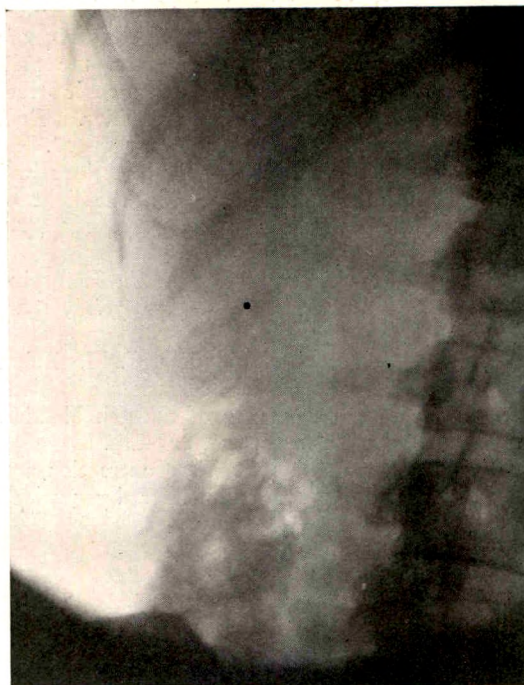


FIG. 6b. Dye shadow after a fat meal. The gall-bladder mucosa seems to follow the dye shadow contraction.

In Figures 6a and 6b those who believe in contraction will say that the shadow represents the outline of the gall-bladder. This may be the case and still be accounted for by absorption, especially if the gall-bladder were absorbing its contents and no more bile were entering through the cystic duct.\*

\* These cases were studied in the Gastro-enterology Department of the Cornell Clinic under Dr. S. Weintraub. The roentgenograms were taken in the Department of Roentgenology of Cornell Clinic under Dr. J. R. Carty. To Dr. W. W. Belden of the Department of Roentgenology, New York Hospital, we are indebted for the roentgenograms in Figures 1a, 1b and 1c.

## REFERENCES

1. BLOND, K. Zur Gallenblasenphysiologie und Pathologie. *Klin. Wchnschr.*, 1927, 6, 1606-1608.
2. BOYDEN, E. A., and BIRCH, C. L. Conditions affecting emptying-time of human gall-bladder. *Proc. Soc. Exper. Biol. & Med.*, 1927, 24, 827-831.
3. BOYDEN, E. A. Concerning the prevalent denials of functions long attributed to gall-bladder. *Surg., Gynec. & Obst.*, 1928, 46, 30-41.
4. DEMEL, R., and BRUMMELKAMP, R. Ein Beitrag zur Funktion der Gallenblase. *Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 1924, 37, 515.
5. GRAHAM, E. A. New developments in our knowledge of the gall bladder. *Am. J. M. Sc.*, 1926, 172, 625-643.
6. GRAHAM, E. A. Present status of cholecystography, and remarks on the mechanism of emptying of gall-bladder. *Surg., Gynec. & Obst.*, 1927, 44, 153-162.

7. HALPERT, B. Neue Wege in der Gallenblasenfor-  
schung. I and II. *Med. Klin.*, 1924, 20, 408;  
1830. Morphological studies on the gall-  
bladder; developments and microscopic struc-  
ture of normal human gall-bladder. *Bull.*  
*Johns Hopkins Hosp.*, 1927, 40, 390-408.
8. HALPERT, B. Gall-bladder; its functions and  
some of their disturbances in the light of  
recent investigation. *Arch. Surg.*, 1929, 19,  
1037-1060.
9. HIGGINS, G. M., and MANN, F. C. Emptying  
of the gall-bladder. *Am. J. Physiol.*, 1926,  
78, 339-348.
10. HIGGINS, G. M., and WILHELMJ, C. M. Effect  
of intravenous injections of various emulsions  
of fat on the emptying of the gall bladder.  
*Am. J. M. Sc.*, 1929, 178, 805-813.
11. IVY, A. C., and OLDBERG, E. Contraction and  
evacuation of the gallbladder by purified  
"secretin" preparation. *J. Am. M. Ass.*,  
1928, 90, 445-446.
12. McMASTER, P. D., and ELMAN, R. Physiolog-  
ical variations in resistance to bile flow to  
intestine. *J. Exper. Med.*, 1926, 47, 151-171.
13. SWEET, J. E. The gall-bladder, its past, present,  
future. *Internat. Clin.*, 1924, 1, 187.
14. SWEET, J. E. The importance to surgery of the  
cystic duct. *Am. J. Surg.*, 1927, 3, 274-280.
15. SWEET, J. E. The function of the gall-bladder.  
*Ann. Surg.*, 1929, 90, 939-947.
16. WHITAKER, L. R. Mechanism of gall-bladder.  
*Am. J. Physiol.*, 1926, 78, 411-436.
17. WINKELSTEIN, A. Motor mechanism of the  
gall-bladder. *J. Am. M. Ass.*, 1923, 80, 1748-  
1750.
18. WINKELSTEIN, A., and ASCHNER, P. W. Mech-  
anism of the flow of bile from liver into  
intestines. *Am. J. M. Sc.*, 1926, 171, 104-111



## HYPERPLASIA OF THE THYMUS

### A STUDY OF 1045 PATIENTS INCLUDING AVAILABLE FAMILY AND MATERNAL HISTORY

By SAM W. DONALDSON, M.D.

*St. Joseph's Mercy Hospital*

ANN ARBOR, MICHIGAN

CONVULSIVE seizures in infants, an age old topic, may be from various causes, but the one cause which is of interest to a larger group than any other is that of persistent thymus.

This condition has been discussed in many phases by pathologists, roentgenologists, pediatricians and obstetricians but apparently so far it has not been studied from the standpoint of heredity.

Since the introduction by Lange<sup>10</sup> in 1911 of roentgen therapy for this particular condition, the question of both diagnosis and treatment has usually been determined by the roentgen examination.

The pathologists are interested in cases of enlarged thymus because of the fact that they have emphasized the importance of early diagnosis and feel that to some degree the deaths from it are preventable and that they as teachers have not made the desired impression on physicians and students.

The roentgenologists are interested in cases of enlarged thymus because in their hands lies the diagnosis and treatment.<sup>17</sup>

The pediatricians are interested in cases of enlarged thymus because it is a condition existing almost wholly in their field, a large percentage of cases being discovered and treated during early childhood. It is of utmost importance for them to exclude this as well as all other possible complications during the diseases of early childhood, especially during the tonsil and adenoid age.<sup>12</sup>

The obstetrician is interested in cases of enlarged thymus because the care of the new-born infant is his for a period after delivery and he is often consulted about the baby after the mother has been discharged.

The surgeon is interested in cases of

enlarged thymus more now than he was a few years ago since he realizes that he should know whether or not the patient has a persistent thymus.<sup>14</sup> There is no greater tragedy than that of a supposedly normal child dying during or immediately following the administration of an anesthetic.

#### ANATOMY AND HISTOLOGY

The thymus gland is an organ with two lobes, subdivided into lobules and further divided into medulla and cortex. The cortex is made up of lymphocytes and the medulla of a network of cells in which may be found the characteristic Hassall's corpuscles. The gland lies in the upper anterior mediastinum in close relation to the heart, great vessels, and anterior to the trachea.<sup>16</sup> The thymus evidently reaches its maximum size at birth or shortly afterward and then may vary in size during early life before beginning to atrophy.<sup>19</sup>

#### IMPORTANCE OF DIAGNOSIS

At the present time when so much effort is being devoted to prenatal and postnatal care, and properly directed feeding of infants, it seems that this great danger to the new-born—hyperplasia of the thymus—should not be overlooked. Each year statistics are widely disseminated showing a decrease in infant and maternal mortality, and advice is given about how the figures may be still further lowered. The publication of The Children's Bureau of the U. S. Department of Labor states that convulsions are not usually serious.<sup>8</sup> No mention is made of the influence the condition of enlarged thymus, a preventable cause, has on the death rate of infants. An early diagnosis is of vital importance.

## CLINICAL SIGNS AND SYMPTOMS

All of the clinical signs and symptoms attributed to enlarged thymus have often been enumerated and should constantly be borne in mind to avoid error in diagnosis.<sup>5</sup> They may be listed as: (a) respiratory difficulty; (b) transitory cyanosis, often with unconsciousness; (c) asthenia; (d) snuffles; (e) the so-called thymic stridor; (f) regurgitation, and (g) abnormal sounds during crying.<sup>9</sup> Older children often exhibit one or more of the following indications of the existing condition: (a) undernourishment and pallor, and (b) enlarged and early hypertrophy of the tonsils and adenoids. Some of the thymic symptoms occurring during infancy may be carried on into later years.

## ROENTGEN DIAGNOSIS

Roentgen examination shows a broad convex shadow in the upper superior mediastinum above the shadow of the heart, wider in the lower portion, and sometimes fitting over the upper border of the heart. The thymus shadow shows no appreciable change in size in relation to the cardiac cycle,<sup>2</sup> but does change in size and shape with respiration and effort, such as crying or struggling. Both lobes need not be enlarged to the same degree, and a large thymic shadow does not necessarily mean the presence of clinical symptoms.<sup>4</sup> At times a marked dyspnea may result from a posterior enlargement which gives only a slight increase in breadth to the shadow.

The technique of the roentgen examination should be such as to exclude all possible errors and provide for a differential diagnosis between cardiac enlargement, lung pathology, congenital anomalies, azygos lobe of the lung, and enlarged mediastinal glands.

## TREATMENT

The treatment of an enlarged thymus lies wholly in the use of roentgen rays or radium,<sup>15</sup> the selection of the agent to be used being at the discretion of the radiologist.<sup>6</sup>

The dosage used at present is not so in-

tensive as that used several years ago. This laboratory has found satisfactory results to be obtained by using a fractional schedule, and in cases of a very large thymus by increasing the dosage at each subsequent treatment. Our treatment in these cases has been as follows: 103 kv. (peak); 5 ma., 3 mm. Al filter, 12 in. distance, 3 min. The equipment used with the above setting delivers during this time 55 r with a half-value layer of 2.7 mm. Al Lambda effective through 2.0 mm. Al, 0.38Å. No ill effects have been noted in any of the cases treated and this dosage is not considered detrimental to the child.<sup>7</sup>

## RESPONSE TO TREATMENT

Re-examination of the chest after therapy has shown a decrease in size of the thymic shadow in all except a few cases. Symptoms when present, and explained by the presence of the thymic shadow, have disappeared in all cases during the course of treatment. Four treatments are usually administered to those patients having a large thymic shadow.

There appears to be a certain type of enlargement of the thymus gland which does not diminish appreciably in size even after extensive treatment although the symptoms subside. While this is contrary to the findings of Spohn,<sup>20</sup> we have had 15 such cases.

The entire structure evidently becomes fibrous in nature and this of course does not show any effects of the treatment administered. In other cases when there is no demonstrable lateral enlargement, an encroachment on the structures posteriorly by increase in size of the gland in this direction may give rise to symptoms. Even if no enlargement can be seen in either direction, but symptoms are present, therapy is indicated.<sup>13</sup> Following this therapeutic test, if the condition is caused by the thymus, the symptoms will shortly disappear.

## OBSERVATIONS

The cases which were observed as a basis for this article were divided into three



Groups, I, II and III. Group I is further subdivided into I (a) and I (b). Group I (a) consists of 500 consecutive newborn infants who were examined from twenty-four to forty-eight hours after birth; I (b) consists of infants a few hours to a few days old, who were born in the hospital but were examined only because there were indications that they might have an enlarged thymus. This series consists of those examined before a routine roentgen examination of all babies born in the hospital was inaugurated.

Group II is made up of a series of infants ranging from a few hours to six months of age who were referred to the hospital for examination because of some symptom, or as a part of a general examination by a physician. In this group, 68 cases were referred for examination because of symptoms attributed to an enlarged thymus;<sup>18</sup> 24 of these were negative from a roentgen standpoint. Nevertheless, the number of positive findings is enough to convince one that a history of symptoms cannot be disregarded.

Group III consists of children referred for roentgen examination of the chest prior to operation for tonsils, adenoids, harelip, extraction of a foreign body from the bronchi, or because of suspicion of some chest condition.

Consideration will first be given to Group I (a) and (b) as the available records on the cases under the other two groups reveal little relative to the early history of the patient or members of the family.

#### RELATION TO SEX

The proportion of females with a positive finding in this series is slightly in excess of the males. However, this excess is not sufficient to indicate that females are always more likely to have enlargement of the thymus gland. Barnett<sup>1</sup> also shows a predominance of females.

#### BIRTH WEIGHT OF THE BABY

The fallacy of the belief that only large babies may have a thymus shadow is well

#### GROUP I (a)

EXAMINATION OF THE CHESTS OF 500 CONSECUTIVE NEW-BORN APPROXIMATELY 24-48 HOURS AFTER BIRTH.

Weight lb.	Total	Positive	Border-line	Negative
4½- 5	11		1	10
5 - 5½	7		2	5
5½- 6	16	2		14
6 - 6½	37	1	1	35
6½- 7	67	10	2	55
7 - 7½	102	14	6	82
7½- 8	76	8	4	64
8 - 8½	88	14	6	68
8½- 9	40	8	5	27
9 - 9½	26	5	1	20
9½-10	23	10		13
10 -10½	3			3
10½-11	3	1	1	1
11 -11½	1	1		
	500	74	29	397

Mother's age	Total	Positive	Border-line	Negative
16	1			1
17	1	1		
18	2			2
19	15			15
20	18	2		16
21	27	3	2	22
22	28	1	3	24
23	34	5	1	28
24	30	2	3	25
25	40	6	3	31
26	38	7	1	30
27	36	5	4	27
28	36	5	1	30
29	31	7	3	21
30	29	5	1	23
31	23	6	1	16
32	16	3	1	12
33	17	2	2	13
34	16	2	1	13
35	10	2		8
36	11	1		10
37	7	1	1	5
38	16	5	1	10
39	5	1		4
40	2			2
41	5	2		3
42	3			3
43	1			1
44	2			2
	500	74	29	397

Sex	Total	Positive	Border-line	Negative
Male.....	245	34	13	198
Female.....	255	40	16	199
	500	74	29	397

## Thyroid History (Mother)

Condition	Total	Positive	Border-line	Negative
Enlargement	64	12	6	46
Surgical....	9	1		8
Treatment..	6	2	1	3
Negative....	421	59	22	340
	500	74	29	397

## Number of Child (Pregnancy)

Pregnancy	Total	Positive	Border-line	Negative
1st	259	24	13	222
2d	126	27	11	88
3d	64	17	2	45
4th	30	5	2	23
5th	14	1	1	12
6th	3			3
7th	3			3
8th				
9th	1			1
	500	74	29	397

## Number of Mothers Having had a Miscarriage or Stillbirth

Total	Positive	Borderline	Negative
29	4	1	24

## Family Record

	Total	Positive	Border-line	Negative
Former children negative.....	44	0	3	41
Former children positive.....	33	24	2	7
First pregnancy.....	259	24	13	222
No record of former children.....	164	26	11	127
	500	74	29	397

## GROUP I (b)

THIS SERIES IS MADE UP OF 165 NEW-BORN INFANTS WHO WERE REFERRED TO THE ROENTGEN-RAY DEPARTMENT FOR EXAMINATION BECAUSE OF SUSPICIOUS SIGNS OR OTHER INDICATIONS POINTING TOWARDS AN ENLARGED THYMUS. THESE CASES BORN IN THE HOSPITAL ARE COMPARABLE TO GROUP III.

Weight lb.	Total	Positive	Border-line	Negative
4 - 4½	3			3
4½ - 5	2			2
5 - 5½	2			2
5½ - 6	4	1		3
6 - 6½	5	3	1	1
6½ - 7	23	9	2	13
7 - 7½	27	9	2	16
7½ - 8	38	11	7	20
8 - 8½	15	3	1	11
8½ - 9	18	8	1	9
9 - 9½	9	7	2	1
9½ - 10	8	7		1
10 - 10½	8	7		1
10½ - 11	2	2		
11 - 11½	1	1		
	165	68	16	81

Mother's Age	Total	Positive	Border-line	Negative
19	1			1
20	4	1	1	2
21	1			1
22	4	2		2
23	8	2		6
24	13	7		6
25	14	4	2	8
26	16	6	1	9
27	10	6		4
28	24	8	4	12
29	19	9	3	7
30	7	4		3
31	11	4	2	5
32	12	5	2	5
33	2			2
34	4	2		2
35	3	1	1	1
36	4	2		2
37	3	2		1
38	3	2		1
39	1	1		
40				
41				
42				
43				
44	1			1
	165	68	16	81

Sex	Total	Positive	Border-line	Negative
Male.....	80	32	5	43
Female.....	85	36	11	38
	165	68	16	81

## Thyroid History (Mother)

	Total	Positive	Border-line	Negative
Enlargement	18	9	1	8
Surgical....	2	2		
Treatment...	4	2	1	1
Negative....	141	55	14	72
	165	68	16	81

## Number of Children

Pregnancy	Total	Positive	Border-line	Negative
1	67	26	4	37
2	53	17	7	29
3	30	16	4	10
4	10	7		3
5	4	2	1	1
9	1			1
	165	68	16	81

## Mother Having had Miscarriage or Stillbirth

Total	Positive	Borderline	Negative
12	3		9

## Family Record

	Total	Positive	Border-line	Negative
Former children negative.....	7			7
Former children borderline or positive	20	17	3	
First pregnancy....	67	26	4	37
No record of former children.....	71	25	9	37
	165	68	16	81

Group II—Contains 7 cases of former thymus negative with 5 positive and 2 negative in subsequent children.

Group III—Contains 3 cases with former positive findings and all are positive in subsequent children.

## GROUP II

245 CHEST EXAMINATIONS IN CHILDREN RANGING IN AGE FROM SIX MONTHS TO EIGHT YEARS

Sex	Total	Positive	Border-line	Negative
Male.....	132	4	11	117
Female.....	113	7	7	99
Total.....	245	11	18	216

Age	Total	Positive	Border-line	Negative
6 mos.	22	2	3	17
6 mos.—1 yr.	13	1	2	10
1½ yrs.	13	1	2	10
2 yrs.	25	4	4	17
3 yrs.	26	1	1	24
4 yrs.	28	2	2	24
5 yrs.	24		1	23
6 yrs.	36		1	35
7 yrs.	21			
8 yrs.	26		1	25
Age not given	11		1	10
	245	11	18	216

Symptoms	Total	Positive	Border-line	Negative
Yes	4	1		3
No	65	2	5	58

Diagnosis	Total	Positive	Border-line	Negative
Chest pathology.....	63	1	2	60
Preoperative.....	25	4	4	17
Cleft palate; hare lip.	37	4	6	27
*Others.....	49	2	5	42
No diagnosis.....	71		1	70
	245	11	18	216

\* Preliminary diagnosis—tuberculous glands, foreign body of the esophagus or bronchi, malnutrition, congenital heart, epilepsy, etc.

Number of Child	Total	Positive	Border-line	Negative
1	42	3	6	33
2	31	1	3	27
3	19	3	2	14
4	7			7
5	3			3
6	1			1
12	1			1
Not classified*	141	4	7	130
Total	245	11	18	216

\* In hospital and out-patient department records the number of brothers and sisters not always enumerated.

### GROUP III

GROUP III CONSISTS OF 135 CASES OF INFANTS RANGING IN AGE FROM NEW-BORN TO SIX MONTHS OF AGE FROM OUT-PATIENT DEPARTMENT AND REFERRED FOR X-RAY EXAMINATION ONLY.

Sex	Total	Positive	Border-line	Negative
Male.....	85	40	4	41
Female.....	50	15	2	33
Total.....	135	55	6	74

Symptoms	Total	Positive	Border-line	Negative
Symptoms.....	68	41	3	24
No symptoms or no information.....	48	9	1	38
Questionable symptoms.....	19	5	2	12
	135	55	6	74

Classification	Total	Positive	Border-line	Negative
Group I (a)	500	74	29	397
I (b)	165	68	16	81
Group II....	245	11	18	216
Group III....	135	55	6	74
	1045	208	69	768

shown in this series under both divisions of Group I. Although there is a tendency towards a higher percentage in the larger babies, it is to be noted that Group I (b) are selected cases. During the collection of Group I (b) all new-born above 8 pounds were examined, while the smaller babies were excluded, since at that time the impression was that only large babies and those with symptoms should be referred for roentgen examination. In certain families studied all of the children have been large. Two families in particular have had no babies weighing under 9 pounds and all of these were found to have an enlarged thymus.

### MOTHERS WITH THYROID HISTORY

Practically all of the mothers in the cases tabulated come from this section of the country which is considered a goiter belt. A review of the histories of these maternity patients shows that a large number of the women, when admitted to the hospital, showed an enlargement of the thyroid sufficient to be noted when physical examination was made. Some few had had thyroid surgery, while others had received treatment.

Knowing that thyroid disturbance is more prevalent among females, and finding that the enlarged thymus occurs more frequently on the whole from mothers with an enlarged thyroid than from those with a normal thyroid gland, we arrived at the conclusion that there may be a relation between the two, but there is not enough evidence to prove this to be a fact.

If one is to regard the condition of enlarged thymus as a familial affair, then it must be assumed that the above findings are coincidental and probably due to the fact that the mothers are from a district where thyroid enlargement is exceedingly common.

### AGE OF THE MOTHER

The conclusions drawn from this series of cases is that the age of the mother has no direct bearing on the finding of an en-



larged thymus. This conclusion is contrary to the findings of Miller and Peterson.<sup>11</sup>

#### NUMBER OF CHILDREN

The primiparae are in preponderance in Group I but we see no reason to believe that there is a probability that the danger of an enlarged thymus increases with each successive child. It is definitely shown that the primipara having a child with an enlarged thymus must be placed in a class likely to have the same condition existing in each succeeding child. The same appears to be true with the finding of a negative thymus.

#### HISTORY OF FORMER THYMUS

The percentage of positive findings in this class where former children have had an enlarged thymus is startling and it is shown that in some families as many as 4 or all of their children have had such a diagnosis. In collecting this group of infants only roentgen evidence or autopsy diagnosis was considered. There are some, however, who probably should be included in this classification where no such records were available. Histories obtained from parents or physicians pointed out the fact that former children had suffered from the classical symptoms of thymic enlargement and in some cases an unexplainable sudden death of an infant had occurred.

#### OBESITY IN THE PARENTS

In Group I, one mother weighing 320 pounds had a female child with a positive thymus while another mother weighing 280 pounds had a male child with a negative thymus. Group I (a) also includes two mothers weighing over 220 pounds having a negative record for their babies. In Group II the father of a male infant with enlarged thymus weighed 240 pounds. Therefore it would seem that obesity in the parents is not a contributing cause of thymic enlargement.

#### SYPHILIS

Two mothers who had been treated for syphilis and had had positive Wassermann

reactions and several miscarriages, both had children with negative thymus findings.

#### MOTHERS HAVING HAD A MISCARRIAGE OR STILLBIRTH

Tabulation was also made of the mothers having a history of a miscarriage or stillbirth. The number of positive findings in this group is no higher than among the mothers who had not had such a termination of pregnancy. As the thymus gland has been considered a factor in asphyxia neonatorum<sup>3</sup> it was hoped that some information might be obtained. Nothing was brought out to prove that an enlarged thymus was the cause of premature death in the previous children.

The chart of family records shows 7 sets of twins, 5 sets with a negative thymus in both children, one set with a positive thymus in both, and one set with a normal chest in one infant but with a thymus shadow in the other. There was also found one set of triplets with normal chests in all three children.

The data relative to an enlarged or normal thymus in some of the children of families Numbers 11, 18, 19, 23, 30, and 49 are taken from the autopsy records of these patients.

In the cases where the classification of the family is doubtful, viz., 69, 70, 72, 78, 85 and 88, the oldest children were in Group III, with the exception of family 70. It is shown in the tables of Group III that no positive thymus shadows are recorded after the age of four years. The age of these children when examined may account for the negative thymus finding, as the subsequent children were examined shortly after birth.

There is a complete record of 94 families regarding the thymus gland shadow. This covers the examination of 212 babies of these families. Of these, the husbands of families 92 and 93, 85 and 86, and 56 and 57 are related. The related families are found to be classified the same. In the same series there are also cases of sisters, whose

## FAMILY RECORD

Family	Class	Thyroid History	Total Children	Legend: — negative b borderling × positive						
				Child examined						
				1	2	3	4	5	6	7
1	Neg.	Neg.	5				=	b		
2	Pos.	Neg.	2	×	b					
3	Pos.	Enlarged	2	×	×					
4	Pos.	Neg.	4			b	×			
5	Neg.	Neg.	2	—	—					
6	Pos.	Neg.	4		×	×	×			
7	Pos.	Neg.	2	×	×					
8	Neg.	Neg.	2	—	—					
9	Neg.	Neg.	2	—	—					
10	Neg.	Neg.	2	—	—					
11	Pos.	Neg.	2	×	×					
12	Neg.	Treated	2	—	—					
13	Neg.	Neg.	2	—	—					
14	Neg.	Neg.	3		—	—				
15	Pos.	Neg.	4		×		×			
16	Pos.	Neg.	3		×	×				
17	Neg.	Neg.	2	—	—					
18	Pos.	Neg.	4		×	×	×			
19	Pos.	Neg.	5		×	×	×	×		
20	Pos.	Enlarged	2	b	b					
21	Neg.	Neg.	2	—	—					
22	Neg.	Surgical	5				—	=		
23	Pos.	Neg.	2	×	×					
24	Neg.	Neg.	3		—	=				
25	?	Neg.	4			×	—			
26	Neg.	Neg.	2	—	—					
27	Neg.	Neg.	2	—	—					
28	Neg.	Neg.	2	—	—					
29	Pos.	Neg.	5		×	×	×	×		
30	Pos.	Treated	4	×	×	×	×			
31	Pos.	Neg.	3		×	×				
32	Pos.	Neg.	3	×	×	×				
33	?	Neg.	2	×	—					
34	Neg.	Neg.	2	—	—					
35	Pos.	Neg.	2	b	×					
36	Pos.	Neg.	2	×	×					
37	Neg.	Neg.	2	—	—					
38	Pos.	Neg.	4			b	×			
39	?	Neg.	4			×	—			
40	Pos.	Neg.	4			×	×			
41	Pos.	Neg.	3	×	×	×				
42	Neg.	Neg.	3		—	—				
43	Pos.	Neg.	4			×	×			
44	Neg.	Neg.	2	=						
45	Neg.	Neg.	2	=						
46	Neg.	Neg.	3	—		—				
47	?	Neg.	2	×	—					

## FAMILY RECORD (Cont.)

Family	Class	Thyroid History	Total Children	Child examined						
				2	3	4	5	6	7	
48	Neg.	Neg.	2	—	—					
49	Pos.	Neg.	4		×		×			
50	Pos.	Neg.	4	b		×	b			
51	Neg.	Neg.	2	—						
52	?	Neg.	6				b		—	
53	Neg.	Neg.	2	—	—					
54	Neg.	Neg.	2	—	—					
55	Neg.	Neg.	4			—	—			
56	Neg.	Neg.	2	—	—					
57	Neg.	Neg.	2	—	—					
58	Pos.	Neg.	2	×	×					
59	Pos.	Neg.	2	×	×					
60	Neg.	Neg.	2	—	=					
61	Neg.	Neg.	3	—		—				
62	?	Neg.	2	b	×					
63	Pos.	Neg.	2	b	b					
64	Pos.	Neg.	2	b	b					
65	Neg.	Neg.	2	—	—					
66	Neg.	Neg.	2	—	—					
67	Neg.	Neg.	5			—		—		
68	Neg.	Neg.	4			—	—			
69	?	Neg.	2	—	×					
70	?	Neg.	3	—	b	—				
71	Neg.	Neg.	6			—	—	—	—	
72	?	Neg.	3		—	×				
73	Pos.	Pos.	3		×	×				
74	?	Neg.	4			×	—			
75	Neg.	Neg.	3		—	—				
76	?	Neg.	4			—	b			
77	Neg.	Neg.	7			—	—	—	—	
78	?	Neg.	4			—	×			
79	Pos.	Neg.	2	×	×					
80	Neg.	Neg.	3	—	—	—				
81	Pos.	Neg.	3		×	×				
82	Pos.	Neg.	2	×	×					
83	Neg.	Neg.	5				—	—		
84	Neg.	Neg.	2	—	—					
85	?	Neg.	2	—	×					
86	Neg.	Neg.	4			—	—			
87	Neg.	Neg.	2	—	—					
88	Neg.	Neg.	3		—	×				
89	Pos.	Neg.	2	×	×					
90	Neg.	Neg.	2	—	—					
91	Pos.	Neg.	3	×	×	×				
92	Pos.	Neg.	2	×	×					
93	Pos.	Neg.	3		×	×				
94	Neg.	Neg.	2	—	—					

— negative  
 Legend: b borderline  
 × positive

babies have been negative, but so far only one child has been born to each.

SUMMARY OF FAMILY RECORDS

	Total	Posi- tive	Border- line	Nega- tive
Former children nega- tive.....	58	5	3	50
Former children posi- tive or borderline..	36	44	5	7
	114	49	8	57

Of the 94 families, 36 are classified as having children with thymic enlargement, 45 as negative regarding this condition and the remaining 13 as being doubtful. Of the 36 positive families, there is a history of thyroid disturbance in 4 mothers, while in the 45 negative families there are only 2 with a thyroid history. There is no significant evidence present to substantiate the belief that some underlying relation between the two organs has a bearing on the condition known as hyperplasia of the thymus.

## CONCLUSIONS

1. Enlargement of the thymus appears to belong to family groups and the majority of the children in these families exhibit this condition.
2. Roentgen examination is indicated

in all children when a history of previous children of that family shows an enlarged thymus.

3. Certain types of thymic enlargement do not decrease in size after irradiation, but the symptoms in these cases subside.

4. There is only unconvincing evidence that there may be a relation between enlarged thymus in the offspring and thyroid disturbance in the mother.

5. The age of the mother apparently has no bearing on the size of the thymus.

6. There is no evidence to show that multiparity has any relation to thymic hyperplasia.

7. Obesity of the parents apparently has no relation to the finding of an enlarged thymus in the children.

8. While there is some evidence that larger babies are more apt to have enlargement of the thymus than smaller ones, this is not enough to limit investigation to the large babies only.

9. The finding of a shadow of an enlarged thymus is slightly more common in females in this series of cases.

10. Enlargement of the thymus does not necessarily indicate that the child will show symptoms.

11. An early diagnosis of the condition is of vital importance.

12. The diagnosis and treatment of an enlarged thymus is a problem of the radiologist.

## REFERENCES

1. BARNETT, E. J. Thymus gland enlargement in infants. *Northwest M. J.*, 1923, 22, 387-392.
2. DEBUYS, L. R., and SAMUEL, E. C. Further observations upon the shadows of the thymus and heart. *South. M. J.*, 1924, 17, 260-264.
3. EVANS, W. A. Roentgen studies of the thoraces of the stillborn and newborn. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1922, 9, 613-617.
4. GREENTHAL, R. M. The incidence of thymic enlargement without symptoms in infants and children. *Am. J. Dis. Child.*, 1922, 24, 433-440.
5. GRIER, G. W. The diagnosis and treatment of enlarged thymus. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1924, 17, 141-146.
6. GRIER, G. W. Enlarged thymus; differential diagnosis and radium treatment. *Atlantic M. J.*, 1925, 28, 502-506.
7. HESS, G. H. Possible developmental defects following over-radiation of the thymus in early infancy. *Radiology*, 1927, 9, 506-509.
8. Infant Care, U. S. Department of Labor, Children's Bureau Publications.
9. KING, J. C. Thymic enlargement in children; its diagnosis and treatment. *Radiology*, 1927, 9, 148-152.
10. LANGE, S. X-ray therapy of enlarged thymus. *Lancet-Clinic.*, 1911, 105, 410-413. Also *Am. Quarterly Roentgenol.*, April, 1911.
11. MILLER, N. F., and PETERSON, R. Thymus of the new-born and its significance to the obstetrician. *J. Am. M. Ass.*, 1924, 83, 234-238.



2. MOSHER, H. P., MACMILLAN, A. S., and MOTLEY, F. E. A clinical and preoperative study of the thymus in children of the tonsil and adenoid age. *Laryngoscope*, 1926, 36, 1130.
13. NOBACK, G. J. The thymus in the newborn and early infancy. *Radiology*, 1926, 7, 416-421.
14. PERKINS, C. W. Roentgen study of 500 children for thymic enlargement. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1926, 15, 216-222.
15. PFAHLER, G. E. The diagnosis of enlarged thymus by the x-ray; and treatment by x-ray or radium. *Arch. Pediat.*, 1924, 41, 39-46.
16. PIERSOL. Human Anatomy.
17. REMER, J., and BELDEN, W. W. Roentgen diagnosis and therapy of the thymus in children. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1927, 18, 119-124.
18. REUBEN, M. S., and FOX, H. R. Relation of thymus to thymic syndrome. *Arch. Pediat.*, 1926, 43, 555-558.
19. SCAMMON, R. E. Studies on the growth and structure of the infant thorax. *Radiology*, 1927, 9, 89-103.
20. SPOHN, H. Diagnosis and treatment of enlarged thymus in children. *Northwest. M. J.*, 1923, 22, 392-397.



## ANGIO- (PERIVASCULAR) ENDOTHELIAL: ABOUT THE JAWS\*

By SANFORD WITHERS, M.D.

DENVER, COLORADO

ENDOTHELIOMA is the name given to a group of neoplasms believed to be derived from the lining cells of blood and lymph vessels, lymph spaces and serous cavities. These cells are derived from the mesenchyma of the embryo and are closely related to connective tissue structures, retaining certain potentialities of connective tissue cells yet assuming some of the histological characteristics of epithelial cells.

Borrmann<sup>1</sup> has constructed an histogenetic classification including hemangio-endothelioma, lymphangio-endothelioma, capillary endothelioma, perithelioma and peri-endothelioma. This classification is in general use but presents the disadvantage that not all growths can be accurately classified, because it is not possible to state, with certainty, whether a certain growth arises from lymph vessel or space or blood vessel or capillary. Ewing<sup>2</sup> classifies these growths as perivascular endotheliomas, but this term, *perivascular*, is slightly misleading as their origin is *intravascular*. I have called these endothelial tumors that surround and invade vascular paths, *angio-endotheliomas*.

The origin of the endothelioma in most cases is from the lining cells of small vessels or lymph spaces; from this source the growth proceeds either by extension and invasion or by the continuous transformation of adjoining cells into tumor cells. I am not prepared to take sides on the controversy that exists on the method of extension of endotheliomas as this point is of little importance in the recognition and treatment of these growths.

I do want to emphasize especially that the endotheliomas arising about the jaws do not metastasize even after repeated attempts at surgical destruction. However, after such procedures, the growth is usually

accelerated and the cells tend to become more embryonal in type.

This fact, together with their infiltrating character which makes them noted for persistent local recurrence, makes it necessary to treat well beyond the probable margins of the growth. However, it is not necessary to consider the regional lymphatics involved and treat them routinely as with sarcoma or carcinoma.

I wish to report 4 cases of angio-endothelioma that involved the jaws. The point of origin of the growth in Cases I, II and III seemed to be in the foramina of exit from the jaws of blood and lymph vessels. Case IV originated in the inferior dental canal at the apex of the first lower molar.

Inasmuch as all of these cases were misdiagnosed by local pathologists as either carcinoma or sarcoma, it may be well to discuss the histology of these cases in some detail.

The cells of vascular endothelioma are small and cuboidal or cylindrical in shape, staining deeply with hematoxylin. The cytoplasm frequently is not clear and pale as with endotheliomata arising from peritoneal surfaces but contains granular masses which sometimes obliterate the nuclear structure. There can usually be found in some part of the section the typical nucleus, which is characterized by being pale and showing definite darkly staining nucleoli.

"An intimate relation to the supporting stroma is an important structural peculiarity which distinguishes many endotheliomas from epithelial tumors. The cells cling to the walls of spaces in spite of the shrinkage of hardening and the cell bodies may be seen to pass insensibly into the substance of the stroma. Small fibroblasts and fine fibrils may ramify between the endothelial cells. . . ."

\* Read at the Fifteenth Annual Meeting, American Radium Society, Detroit, Mich., June 23-24, 1930.

sign of endothelioma is the loss of the characters of the cells described but these characters are lost in any actively growing tumors and in recurrences. Yet a thorough search for the translucent polyhedral cells with pale nuclei, devoid of acidophile nucleoli is often rewarded in tumors the bulk of which fails to show such cell types. . . . I have never seen definite pearl formation in any undoubted endothelioma. . . . The desmoplastic properties of many endotheliomas assist in this recognition, and a peculiar form of hyalinosis may sharpen this feature" (Ewing).

It must not be supposed that the microscopic slide will make the diagnosis in all cases, even if it is examined by a good pathologist. He should be furnished with an accurate history and description of the growth. This point is illustrated by Case IV. The section seemingly showed a rapidly developing carcinoma of grade 3. There were many atypical mitotic figures, little evidence of differentiation and definite invasion shown and *the growth had not metastasized even though five attempts had been made to excise it*. The correct diagnosis was made in this case from a section removed at the second operation which showed a relatively slow-growing, benign-appearing angio-endothelioma.

The following 4 brief case reports with photomicrographs of the slides are self-explanatory:

#### CASE REPORTS

CASE I. M. C., female, aged twenty-three, examined Sept. 20, 1923. Diagnosis of section by Dr. James Ewing: Lymphangio-endothelioma.

History. Three months before examination the patient noticed a small red pimple just to the left of the midline in the vault of the hard palate. This had become the size of a large pea and was excised down to the periosteum nine days before my first examination.

Examination showed an area of ulceration of the hard palate about 1.5 cm. in diameter with tiny bright red nodules about the margin. This crater and margin were given 250 mg-hr. of radium in dental compound. There has been no recurrence to date.

Figure 1 shows a lobule of the tumor surrounded by a zone of hyperplastic lymphatic channels. These vessels are already showing the overgrowth of intima with obliteration of the lumen with the perivascular growth of the endothelial cells of the intima. About the lobule is also seen a kind of capsule made up of compressed fibrous tissue. Figure 2 shows a small blood vessel in the tumor surrounded by deformed endothelial cells. Many of these exhibit the pale nuclei with multiple, darkly staining nucleoli which are characteristic of this growth. Fibrils of the connective tissue stroma are intimately interwoven between the endothelial cells.

CASE II. A. E., female, aged twenty-four, examined March 13, 1923. Diagnosis of section by Dr. James Ewing: Lymphangio-endothelioma.

History. The patient noticed a small, slowly growing tumor just to the right of the midline of the hard palate one year ago.

Examination. A hard tumor of the vault of the hard palate was found; in size about 2 cm. in diameter, raised about 5 mm. and covered by normal mucous membrane.

Treatment. Four radium needles of 5 mg. each were implanted about the tumor for 13 hours, a total of 260 mg-hr. The growth was excised for diagnosis a few days after the radium was removed.

Figure 3 shows cloudy swelling and thrombosis of the smaller blood vessels. The endothelial cells are growing into and dilating a large lymph space. Figure 4 shows the more minute effects of the radiation on the cells, some of which are pycnotic with deeply staining nuclei; others show beginning disintegration. The blood vessel in the center shows an *intra* and *peri* vascular extension of the endothelial cells of the intima.

CASE III. S. S., female, aged thirty-two. Sections were submitted to me for diagnosis after resection of the growth in June, 1928.

History. This growth seemed to arise under the periosteum near the apex of the lower right molar at the inferior dental foramen about three years previously and had been excised twice before this. In April, 1928, before excision, the growth was about the size of an almond. There has been no recurrence to date. This growth shows the typical modification of the cells resulting from the previous treatment and many atypical nuclei are seen. The lobules



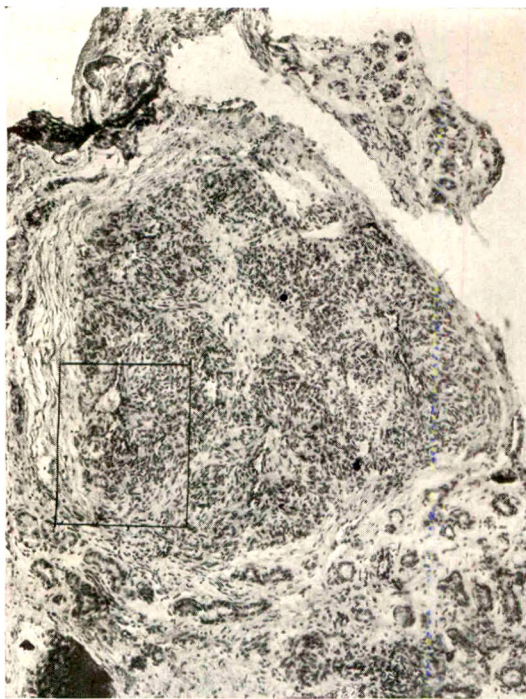


FIG. 1. Case I.

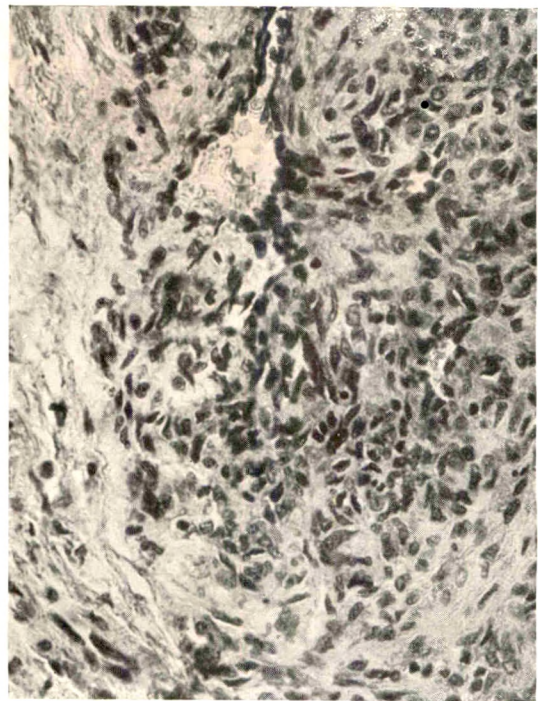


FIG. 2. Case I.

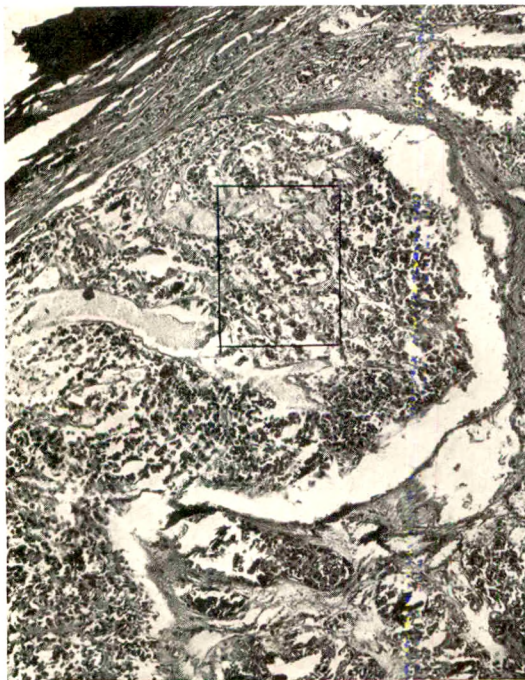


FIG. 3. Case II.

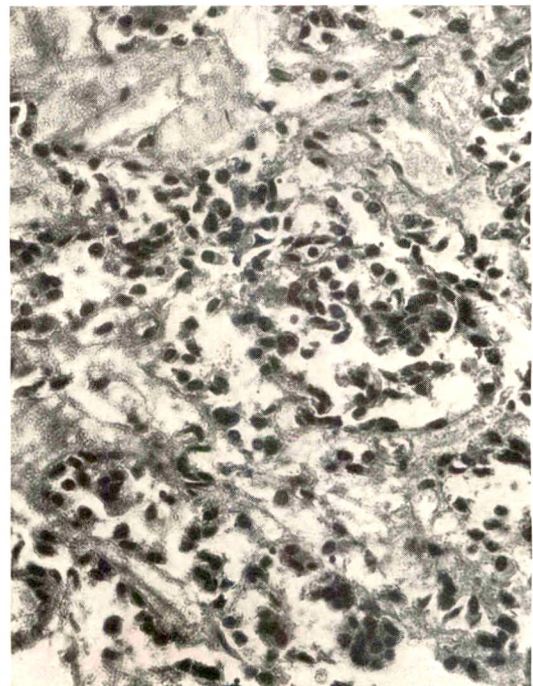


FIG. 4. Case II.



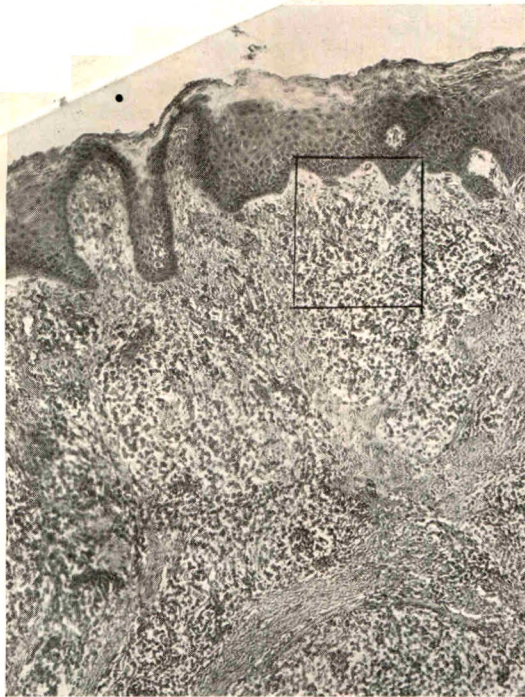


FIG. 5. Case III.

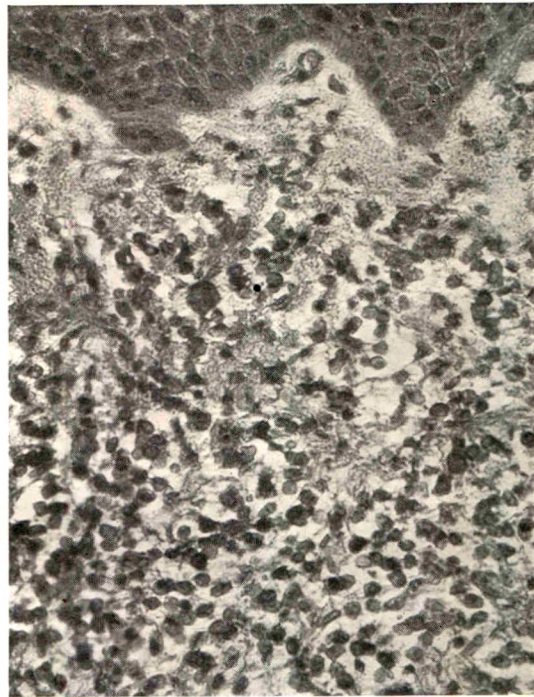


FIG. 6. Case III.

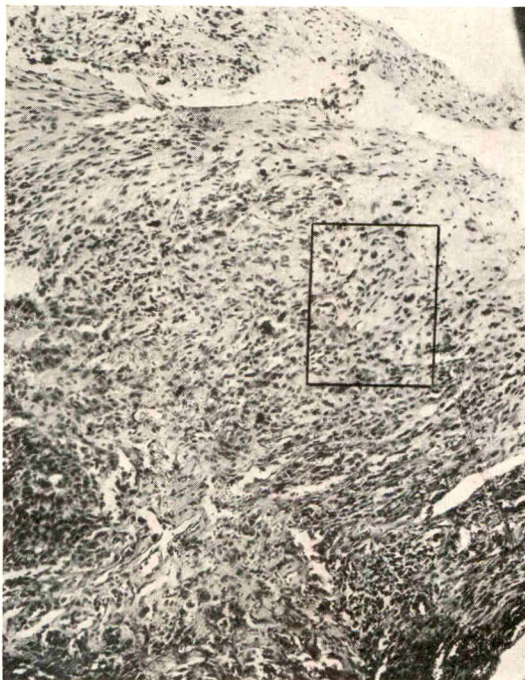


FIG. 7. Case IV.



FIG. 8. Case IV.



of the tumor are separated by connective tissue septa and many fibrils of connective tissue can be seen interwoven between the typical endothelial cells which are characterized by large pale nuclei with darkly staining multiple nucleoli (Figs. 5 and 6).

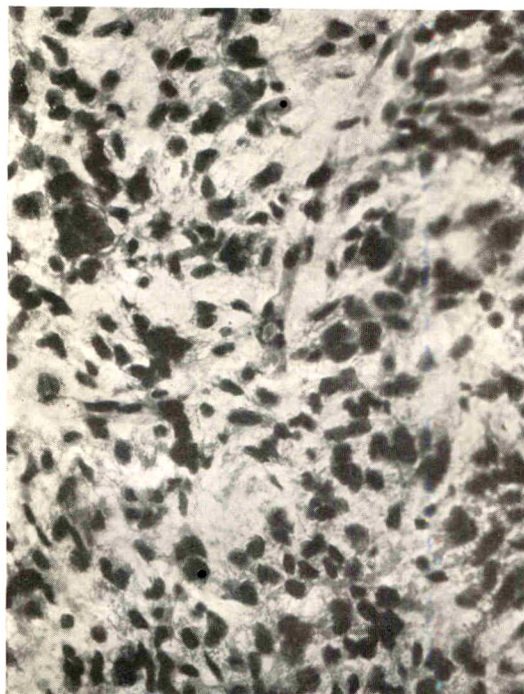


FIG. 9. Case IV.

Note: In this case it would be easy to mistake this growth for an epithelioma as the endothelial cells have grown out to underlie the epithelium.

CASE IV (Figs. 7, 8, and 9). Female, aged thirty-seven. Date of my first examination March 15, 1928. First noticed numbness of chin on left in August, 1927. This woman consulted a surgeon who after having made a roentgen examination of the left mandible told the patient she had a cyst of the jaw.

Five surgical attempts at removal of this growth occurring in the inferior dental canal were made between October, 1927, and Nov.

20, 1928, at indifferent intervals. Treatment by radium and roentgen. The patient could not be convinced to come from one physician to another.

This patient went to the Mayo Clinic Jan. 1, 1929, and the following paragraph from Doctor Broders' letter of Feb. 9, 1929 confirms my diagnosis:

"I agree with your diagnosis of angioendothelioma. We use the terms angioendothelioma and angiosarcoma indiscriminately. When we use the terms lymphangioma or hemangioma the tumors are understood to be benign, but when we use the term lymphangioendothelioma or hemangioendothelioma the tumors are understood to be clinically malignant in varying degrees. Hemangioendothelioma and lymphangioendothelioma are modified sarcomas."

This patient died of an embolus following a severe hemorrhage March 23, 1929.

#### SUMMARY

A brief résumé of the clinical and pathological aspects of angio-endotheliomas has been given in connection with the report of four cases arising in the vascular channels of the jaws.

It is especially urged that vigilance be exercised to differentiate these cases of endotheliomas about the jaws. First, because we need accurate statistics, second, because we must acquire a clear understanding of the methods which will produce a retrogression of the malignancy we are treating, and third, because we must conserve all the normal tissue possible, consistent with thorough treatment.

"Finally, it should be urged that the diagnosis of endothelioma should be accepted only when the evidence is clear and conclusive. Otherwise, this group will continue to represent the resting place of miscellaneous tumors on which the data and study have been inadequate" (Ewing).

#### REFERENCES

1. BORRMANN, ROBERT. Zum Wachsthum und Nomenclatur der Blutgefäßgeschwülste. *Virchow's Arch. f. path. Anat. etc.*, 1899, 157, 297-328.
2. EWING, JAMES. Neoplastic Diseases. W. B. Saunders Co., Philadelphia, 1922. Chapters on Endothelioma.

## DISCUSSION

BUCKS, Detroit, Mich. Dr. [unclear] gave me a copy of his paper, which I [unclear]. I then looked up my records and found my earliest cases, treated when we did not know much about the effect of radium on endotheliomas.

The fact that endothelioma originates from the endothelium of the blood and lymph vessels or the lining of the serous cavities is important but whether this origin is peri- or intravascular is insignificant from the clinical aspect.

The most important observation of the author is that endotheliomata are prone to recur after surgical interference, whether from the knife, cautery or electric needle but that there is no tendency to metastasis. His therapeutic results in three cases are worthy of scientific recognition while the fourth bears out the old maxims that "Procrastination is the thief of time" and that "Too much meddling muddles the outcome."

In reviewing our records, I find that our first case of endothelioma with a pathological biopsy report was treated first in November, 1916, or almost fourteen years ago. It might be of interest to give a brief report of the case.

Mrs. B., aged forty-eight, for two years had noticed a lump within the left cheek. It had been operated upon two months before she

came to us; the biopsy report was benign tumor with a cancerous tendency. It returned within a month and was again operated upon, with a biopsy report of endothelioma. The cavity was curetted carefully and packed with gauze. A small rounded nodule the size of a marble was felt within the mucous membrane of the left cheek near Stenson's duct; this was tender to the touch and showed some induration at the lower border.

Treatment. Radium was used two days after the last operation. As the patient had an extra upper denture, this was utilized for holding the radium and protecting the jaw. Several small holes were drilled through the gum of the plate and a 25 mg. tube screened with 1 mm. brass and rubber was laced to the plate; 50 mg. with the same screenage was laid on 1 cm. gauze and held on the skin surface. All the radium was applied for eleven hours, or a total of 825 mg-hr.

The treatment was repeated in two months. Three months after the last treatment, the progress notes read as follows: No difficulty was experienced after the last treatment; the scar in the mucous membrane is smooth, not contracted and only a small nodule like a split pea can be felt.

She was under observation for several years and was last seen a few months ago, at which time no evidence of recurrence was discernible.



# A CLINICAL EVALUATION OF RADIUM AND ROENTGEN THERAPY IN ADVANCED CANCER WITH VARIOUS COMBINATIONS OF WAVE LENGTHS\*

## A PRELIMINARY REPORT

By BERNARD P. WIDMANN, M.D.      and      J. L. WEATHERWAX, M.A.  
*Assistant Professor of Radiology in the Post Graduate      Physicist to the Radiological Department of the*  
*School of Medicine in the University of      Philadelphia General Hospital and Graduate*  
*Pennsylvania      School of University of Pennsylvania*

PHILADELPHIA, PENNSYLVANIA

THE progress of radium and roentgen therapy must depend upon the development of physical principles and techniques which permit the delivery of greater quantities of radiation to the tumor areas. Much of the success in the future will depend upon the radiologist's ability to develop some means of administering still greater quantities of radiation to the tumor site, of sufficient intensity to destroy cancer cells of various types, and still preserve the integrity of the healthy tissues.

The physicist and biologist are indispensable to this work. Many animal and laboratory experiments are illuminating and explain many diverse phenomena, but not all of these conclusions are readily amenable to clinical application.

If the same "strains" of human beings made up our clinics, if disease in the same anatomical locations of equal duration and extent of involvement could be estimated, if the age and physical condition and the frequent other complicating diseases could be readily and accurately weighed and measured, if and when the type and grade of malignancy according to cellular differentiation is uniformly and accurately standardized and universally adopted, then it might be possible to make some adjustments of these correlated facts with laboratory manifestations, and possibly some firm scientific basis for irradiation of different types of cancers could be evolved.

The value of radium and roentgen rays is indisputable in early cancers of the skin,

mouth, breast and cervix uteri. These agents become even more indispensable in the late cancers of the skin, mouth, breast and cervix uteri, as well as in other advanced and late cancer cases, because in these advanced stages there is no other procedure that offers any hope or benefit.

The late cases are in the majority; they become a burden to their families and communities so that the social and economic problems, aside from the hospital taxations, are of serious importance.

The early skin, mouth and cervix lesions have been amenable to a manifold variety of techniques in experienced hands. The advanced cancers have shown sufficient improvement in some instances to justify intensive irradiation when the physical condition of the patient permitted, not only from the standpoint of relief of pain, but for actually prolonging life. One cannot mathematically estimate this value except by clinical impressions and comparisons with an experience of large groups of cases, where every advantage of systematic irradiation has been carried out to the limit of skin and physical tolerance.

Cancers of the gastrointestinal tract, particularly the adenocarcinomas of the rectum are resistant to radiation. Adenocarcinomas of the cervix are likewise vulnerable. Postoperative irradiation of cancer of the breast with axillary involvement has shown sufficiently improved end-results over surgery alone to justify its use routinely (Pfahler and Widmann<sup>21</sup>). Irradiation of advanced cancer of the

\* From the Radiological Department of the Philadelphia General Hospital, Philadelphia, Pa. Read at the Thirtieth Annual Meeting, American Roentgen Ray Society, New York City, Sept. 17-20, 1929.



# ANEURYSM OF THE HORIZONTAL ARCH WITH AUTOPSY

By GEORGE ROSENBAUM, M.D.  
PHILADELPHIA, PENNSYLVANIA

THE usual definition of an aneurysm is a pulsating tumor, containing blood, and communicating with an artery or a cavity of the heart, the result of more or less limited dilatation of one or more of the arterial coats. Broadly considered, there are two types of aneurysm—fusiform and saccular. Either may exist alone or in a combined form; for instance, when a fusiform type shows a distinct sacculation, or a diverticulum-like pouch is seen in a saccular aneurysm. The horizontal arch is affected in over 80 per cent of all cases, the thoracic or abdominal sections of the aorta being but rarely involved.

According to Hampton and Jones of the Massachusetts General Hospital, the arteriosclerotic arch measures 5.6 cm., while a measurement of 7.8 cm. or over signifies an aneurysm. Luetic aortitis, before the aorta has become dilated or the aortic valve diseased, is frequently not demonstrable, and may result fatally by occlusion of the coronary arteries.

In fully 50 per cent of all cases, even the most expert clinician cannot elicit characteristic objective or subjective signs. This applies especially to the descending arch, which due to its deep position is often not diagnosed, even when of very large size. Also to the experienced roentgenologist, there are frequent occasions when the differential diagnosis of aneurysm from the numerous processes which closely resemble it are practically impossible. The difficulty lies in the fact that the mediastinum is the site of many puzzling masses which simulate aneurysm and the pulmonary and pleural complications that may obscure it.

In the differential diagnosis, the following must be considered: mediastinal tumors, especially sarcoma and lymphosarcoma; the enlargements seen in Hodgkin's

disease and leucemia; dermoid cyst; substernal thyroid; tumors of the lung roots; esophageal diverticula, dilatations or carcinoma, and vertebral caries or tumors.

The symptoms of aneurysm result from pressure or erosion, either of osseous or soft structures or both. Probably the most frequent symptom of pressure is that upon the trachea. This may occur ventrodorsally upon the vertebrae or laterally, and is usually seen upon the roentgenogram, or under the roentgenoscope, especially in the oblique diameter of the thorax. Dysphagia is occasionally the first symptom. Pressure upon the larger bronchi is often present, and while this may not be seen directly, its secondary effects are visible in the form of bronchostenosis, bronchiectasis or pulmonary abscess. In fact, the pulmonary changes are often so marked that they have been aptly designated aneurysmal phthisis.

Usually the first question asked the roentgenologist about a patient with a chest mass is regarding its pulsation. If it has systolic pulsation it must be an aneurysm; if none is seen, then it cannot be. This is a view very commonly held but like so many of the Hippocratic aphorisms, is untrue. Quite the contrary is likely to be the case. Pulsation is rather uncommon, especially after the mass has existed for an appreciable time. Aneurysms, even of the largest size, may not pulsate. The reason is obvious when one notes the enormous thickening of the aneurysmal wall due to repeated inflammation, or as in the case reported, the presence of laminated clots, completely filling the sac. Fusiform aneurysms pulsate more than the saccular type, but mediastinal tumors may pulsate to a greater degree than aneurysm. This is due to transmission from the adjacent aorta or to an inherent vascularity of the tumor itself.

\* Read at the March, 1930, meeting of the Philadelphia Roentgen Ray Society.



FIG. 5. Photomicrograph of a longitudinal section through the papilloma.

Figure 3 shows the gross specimen after removal. Figure 4 shows a drawing illustrating the arrangement of the papilloma in the duodenum and its relation to the pylorus.

**Microscopic Description.** "The sections taken longitudinally through this hanging, polypoid mass show gastric mucosa on the one side and duodenal mucosa on the other. Figure 5 is a photomicrograph of the longitudinal section through the pylorus and duodenum. The gastric mucosa at "A" clearly shows an extraordinary formation of ramifying, glandular downgrowths in patches scattered in the more normal mucosa. In the polyp the epithelial structures become very disorderly, remaining gland-like but very irregular in form. There are tubular glands in the stroma which are drawn up into the polyp, but one cannot be sure that they are not due to tangential cuts of a space between two folds.

"In Figure 6 the same structure is found except that in this section the polyp is more sessile. At the point marked "B" there are very definite downgrowths of epithelium into

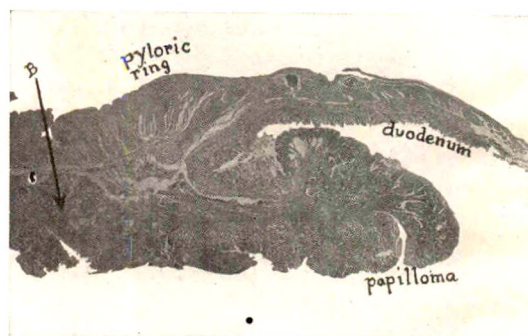


FIG. 6. Photomicrograph of the papilloma showing a tendency to malignant invasion of the gastric mucosa.

the submucosa of the stomach. They look like tubules of epithelium lying in lymph channels and there is a small lymphoid mass in which epithelial cells are lodged. Here they are in minute subdivision and distributed in small groups in the lymph node and in the form of very small tubules. I think this is a definite indication of a tendency to malignant invasion. No tumor has been found deeper than the submucosa, but there the invasion of lymphatics is extensive."

#### CONCLUSION

In suitable subjects, the roentgenoscopic examination should reveal a multilocular type filling defect which is suspicious enough to warrant making numerous films of the duodenal cap of sufficient clearness to justify a definite diagnosis of papilloma, while in adenoma a vacuolated type of filling defect should be definite enough to differentiate between these two types of benign tumor.

#### REFERENCES

1. BALFOUR, D. C., and HENDERSON, E. F. Benign tumors of the duodenum. *Ann. Surg.*, 1929, 89, 30-35.
2. BOOKMAN, M. R. Report of a case of papilloma of the duodenum. *Ann. Surg.*, 1930, 91, 626-629.
3. CAMP, JOHN D. Myoma of the stomach and of the duodenum. *Radiology*, 1924, 2, 262-264.
4. CARMAN, R. D. Hemangioma of the duodenum. *AM. J. ROENTGENOL.*, 1921, 8, 481-482.
5. GOLDEN, ROSS. Non-malignant tumors of the duodenum. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1928, 20, 405-413.



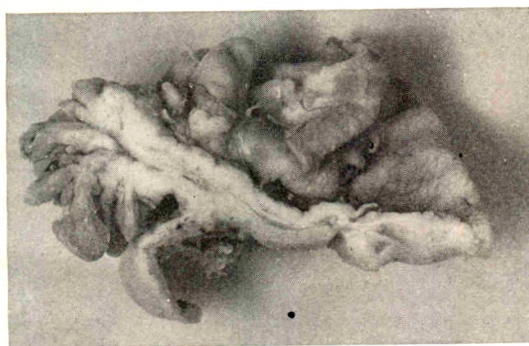


FIG. 3. Photograph of duodenal papilloma after removal.

marginal contours of the duodenal cap seem to be perfectly normal. We made a series of films which shows a definitely enlarged duodenal cap with a smooth contour and a very multilobular type filling defect which seems to be inside the cap. Impression: There is no doubt that there is a lesion, but the etiological factors are certainly very confusing from the roentgenologic point of view. It would seem almost certain that a neoplasm should be considered. This type of filling defect would warrant a diagnosis of papilloma or polyposis."

In studying Figures 1 and 2, it can be seen that the filling defect in the duodenum is a very unusual one and that a diagnosis such as papilloma, from these films, is not such a hazardous guess. However, in neither the roentgenoscopic examination by Dr. Brown or myself, nor in a considerable number of films was this visualized with any such clearness as shown in Figures 1 and 2. This fact is mentioned in order to show the necessity of making films of fine detail in any gastrointestinal examination in addition to the roentgenoscopic examination.

At operation by Dr. J. M. T. Finney on Nov. 25, 1929, an olive-sized mass was discovered in the first part of the duodenum. Incision of the anterior duodenal wall disclosed a lobulated papillomatous tumor on a broad base. A resection was performed. The patient, unfortunately, died of generalized peritonitis four days later.

*Pathological Report.* Dr. W. G. MacCallum, in brief.

**Gross Description.** "The specimen consists of the pylorus of the stomach and the first part of the duodenum which contains a polypoid growth extending into the lumen. There is a

fold of tissue where the... seen and below this point the... however, at another point in... at the same level, the mucosa of the stomach is seen to extend downward and up on to the polyp so that it would appear that the polyp is really derived from the stomach and has been dragged down to lie in the lumen of the first part of the duodenum. This may, however, not be borne out histologically.

"The polyp itself forms a mass measuring 4.5 cm. from base to tip and 5 cm. in diameter in its outer portion. There are, however, other masses of the same tissue which grow out from the base of the polyp in a sessile manner and completely encircle the lumen just below the pylorus.

"On longitudinal section through the more pedunculated portion the stomach mucosa is seen to extend down over the polyp, measuring 1-2 mm. in thickness. Club-shaped processes project from the pedicle in all directions."

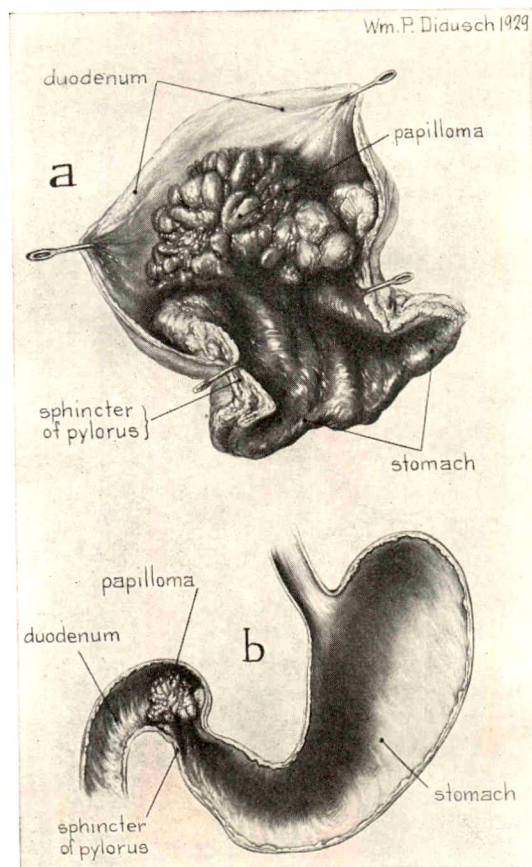


FIG. 4. Drawing showing the arrangement of the papilloma and its relation to the pylorus.



Balfout and Henderson, in 1929, made a further review of the literature on benign tumors of the duodenum and added 4 cases. The usual roentgen diagnosis was duodenal ulcer. The preoperative roentgen diagnosis of papilloma was not made in any of these four cases. The findings were all adenomata one of the polypoid type. Bookman, in 1930, reported one case of papilloma of the duodenum in which the roentgen examination was reported as essentially negative. However, attention was called to the fact that the pylorus was somewhat distorted. In this case an ulcer of the duodenum was found fourteen months previously at operation. It is interesting to note that in the reported benign tumors of the duodenum only four have been diagnosed roentgenologically: the case of Camp's, the one of Carman's, one of Golden's two cases and the author's.

#### CASE REPORT

T. S. male, aged sixty-eight, was referred by Dr. Thomas R. Brown, Nov. 21, 1929, for gastrointestinal examination. There was a history of epigastric discomfort occurring over a period of six months. This was most pronounced in the morning and was sometimes relieved by alkalies or food. For two months prior to examination the discomfort had become almost constant, relief being obtained on the ingestion of a reduced amount of food. Except for a palpable liver edge two finger breadths below the costal margin, the physical examination was negative. The test meal showed achlorhydria—free acid 0, total acidity 8. One specimen of stool revealed occult blood.

The roentgen report in part is as follows: "He has one of the most interesting findings I have ever seen. The pylorus seems to be all right, but as the barium goes through the duodenum it spreads out in a fan-shaped manner as though it were encircling a mass. The

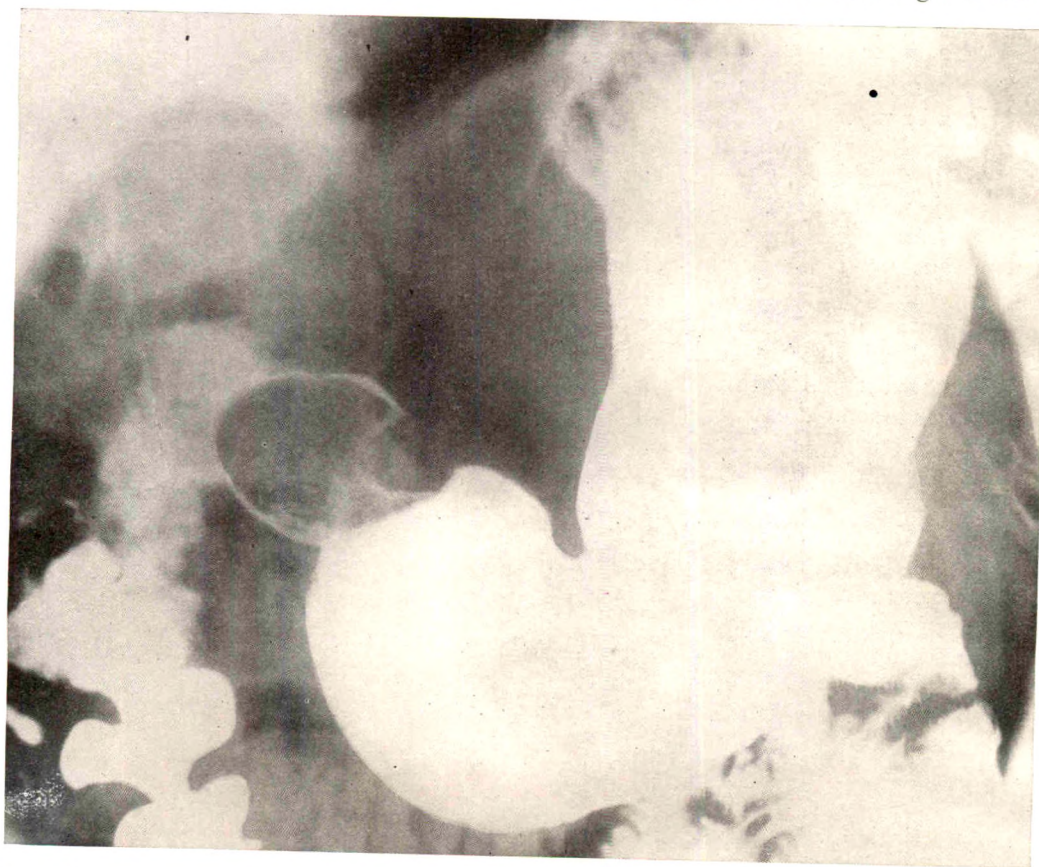


FIG. 2. Roentgenogram showing clear-cut marginal outlines of the empty duodenal bulb. Note that the multilocular appearance of the bulb is still maintained.



breast. In some instances has been beneficial when extended over a period of eight weeks. Many of these advanced operable cases are made operable by this prolonged irradiation, and statistics<sup>23</sup> show a decidedly increased longevity cycle.

Broders,<sup>2</sup> Ewing,<sup>6</sup> Greenough,<sup>9</sup> and Schmitz, Hueper and Arnold,<sup>29</sup> have successfully graded some cancers according to their cellular differentiation, and statistical tables are now substantiating these observations of varying degrees of malignancy for different tumors by microscopic determination.

Advanced cancers of the mouth, breast, cervix, uterus, bladder, prostate, rectum, etc., even with gland and bone metastases, have shown such a variability of response to irradiation that it is clearly evident that there is a definite radiosensitivity of different cancers.

Healy and Cutler<sup>10</sup> brought out the striking paradox that with radiation treatment the prognosis is better with the higher grades of malignancy because the radiosensitivity increases with the malignancy. They divide cervical cancers into three groups: squamous, transitional, and anaplastic. With the squamous type there were few cures by any method and only in the early stages; in the intermediate group the results were about equal from surgery and irradiation, while in the anaplastic group there were no cures by hysterectomy, but the highest proportion, 46 per cent, by irradiation. Ewing<sup>6</sup> regards this as a forceful demonstration of the value of grading epidermoid cancer according to malignancy and radiosensitivity.

There is still considerable danger in planning treatments on the basis of variable intensities of radiation according to the malignancy grading. Not all pathologists will agree on the extent of cellular differentiation. The question is further complicated by the duration of the lesion and the site of the growth from which the specimen is taken.

This does not lessen the clinical impression of variable tumor sensitivity, but the

fact is pointed out to show the advisability of planning radiation treatment on the basis of the limit of skin tolerance and also in accordance with the physical condition of the patient. This is an important factor to be considered in the advanced cases, many of whom are fairly advanced in years. The microscopic grading of cancer in the advanced or late case is probably not important.

So-called acquired resistance to radiation following repeated inadequate dosage is a very general and noteworthy observation. An important factor that renders tumors resistant is their tendency to produce growth of connective tissue. Highly vascular tumors frequently disappear quickly. Complicating infections interfere with successful irradiation.

The general physical condition of the patient probably regulates more than any other single factor the final end-results of irradiation. The constitutional element of a natural body reaction must be considered in tumor radiosensitivity. Good results are rarely to be expected in the weak, anemic and cachectic individuals, whereas a fresh subject in good health, normal blood count and excellent physical endurance may show an extraordinary response for the same extent and type of a given anatomical involvement. These factors complicate rule of thumb procedures for the radiation treatment of advanced cancers.

There is a fairly general agreement that the effect of irradiation is a direct one. Sharply localized treatments to metastatic skin nodules show responses that indicate this effect. Investigations by Regaud<sup>26</sup>, Lacassagne<sup>15</sup>, Wood<sup>33</sup>, and Holthusen<sup>13</sup>, support this contention. While there are many noteworthy observations to suggest an indirect action, there is little uniformity of agreement and the postulations are largely theoretical, and many of the deductions made from animal experiments are confusing and conflicting.

The proper working out of the time distribution of irradiation and an adminis-



tration of a greater quantity of radiation with preservation of normal structures, are factors of great importance if further progress in the radiation treatment of advanced cancer is to be attained.

There are few data, clinical or experimental, to substantiate a selective action by a specific wave length. It has been frequently observed on the basis of clinical observations, that radium shows responses strikingly superior to roentgen rays, in skin and intraoral cancers, and particularly for treatment of metastatic nodules of the neck and skin in mouth and breast cancers. This determination may or may not be an impression of an enthusiast for a particular technique. The element of an individual appraisal may be tempered by technical facilities or the established routine of a particular organization.

Regaud has held for many years that cancer tissue shows a selectivity for specific wave lengths. This is in accord with the experimental work of Russ,<sup>27</sup> and Dognon<sup>5</sup>. In 1924, Wood<sup>32</sup> showed by animal tumor experiments that there was no difference in the lethal effect of long and short wave length radiation. Since the depth dose is largely a function of the wave length, the question of how short a wave length can be to obtain an adequate and satisfactory depth dose is of utmost importance from the standpoint of the maximum skin tolerance dose and the clinical result. Failla<sup>7</sup> believes that if the lethal dose is independent of the wave length, as Wood observed in animal tumors, then further observations on the effect of different wave lengths on human tumors is not essential.

The premise for such a clinical study seems to be all the more justified by virtue of Wood's observations that the biological effect on animal tumors was the same with unfiltered, filtered, or gamma radium rays when the same number of human erythema doses was applied. A depth dose with unfiltered or low filtration, whether of radium or roentgen rays, must fall short of the depth intensities obtained by higher

filtrations and shorter wave lengths of radium and roentgen rays.

According to Holthuser<sup>14</sup>, the biological action changes with the wave length, resulting in a change in its penetrative power, and all the effects of the rays are absolutely independent of wave length. He finds that the biological effect is parallel to the ionization in air. This is in complete agreement with Wood<sup>33</sup>, and Chamberlain<sup>4</sup>, that 500 r is identical for all wave lengths.

Lacassagne<sup>16</sup> supports the theory of a specificity of wave lengths for certain cancer cells. He is opposed to the practice of employing radiations of qualities that are caustic in their effect and argues for the elective action of roentgen and gamma radiation. Lacassagne believes that if a caustic effect is desired, then chemical and physical agents are just as effective and less dangerous.

Strangeways and Hopwood<sup>3</sup> studied tissue cultures for specific effects of different wave lengths of roentgen rays and found the long wave length rays nearly 40 per cent more efficient than the short wave length rays. The difficulties of measuring the back-scattering and the factors of secondary radiation in deep-seated tumors in actual practice cannot be readily adjusted to this conclusion.

Wood<sup>34</sup> has found that 50 per cent of gamma rays and 50 per cent of roentgen rays makes a 100 per cent lethal dose on the eggs of *Drosophila*. His experiments do not indicate an electivity of sensitiveness to different qualities of rays. The radiation factors at varying depths cannot be estimated and correlated for clinical comparisons from these studies.

It is generally considered that roentgen therapy with filtrations beyond 0.5 mm. of copper, with 200 kv., only increases the time of the dose and does not admit of qualities of radiation of any superior therapeutic value. This same attitude has been held to a great extent with regard to radium filtration greater than 2 mm. of brass or the equivalent and more generally used filters of 0.5 mm. of silver and 1 mm. of



ss. Any filtrations greater than these increase the time of an effectual dose according to general be-

This widespread conception is based upon an almost fairly unanimous agreement of physical findings on the basis of our present systems of ionization measurements. In the light of our present knowledge, these can be regarded as fairly accurate, and disagreements are not so much at variance because of actual differences as to the physical factors obtained but rather a lack of agreement as to the proper interpretation of these phenomena.

The German literature indicates a very general use of copper and zinc filters ranging from 0.5 to 2.0 mm. in thickness with high voltage roentgen therapy (200 kv.).

Regaud,<sup>26</sup> Forssell et al.,<sup>8</sup> and Pfahler,<sup>20</sup> are now advocating heavier filters for radium, ranging from 0.5 to 2.0 mm. of platinum. In addition to the increase of filters, Regaud advocates prolonged treatments with low intensities of radium extending in some instances over periods of five to ten days, in order to obtain a uniform effect of irradiation on all cells of a neoplastic area at varying stages of mitosis. Lacassagne and Monod, and Canti<sup>3</sup> demonstrated very conclusively the effect of irradiation at the stage of mitosis. This sensitivity of cells to radiation during the process of division has been studied exhaustively by Alberti and Politzer,<sup>1</sup> Nather and Schinz,<sup>19</sup> Hertwig,<sup>11</sup> Markovits,<sup>17</sup> Mohr,<sup>18</sup> and others.

The clinical results obtained by the use of heavy filters, with both radium and roentgen rays, justifies the longer time necessary to deliver an adequate treatment, according to the statistical reports of the Radiumhemmet, Stockholm,<sup>8</sup> and the Curie Institute of Paris.<sup>26</sup> These improved results are in accord with our experience in the treatment of advanced cancer with the gamma rays of radium.

Canti, Spear and Hopwood<sup>3</sup> in their investigations as to whether it would be better to apply a large intensity of radia-

tion for a short time or a small intensity for a long time, observed from tissue culture experiments that on increasing the distance and thus diminishing the intensity, a longer time was required to produce the cessation of mitosis than would be expected if the action were purely physical, like that of rays on a photographic plate. They further observed that beyond distances of slight intensity, no cessation of mitosis took place, however long the radium was left *in situ*. Interstitial irradiation showed no disappearance of tumor outside a certain radius, no matter how long the radium was left *in situ*.

We have not been able to adjust our doses with heavy filtrations to a satisfactory interpretation of the ionization factors.\* The so-called erythema dose with 0.5 mm. of copper and 200 kv. is based upon the estimation of the "threshold erythema" of Quimby,<sup>24</sup> which will produce a redness or bronzing in about two weeks in the majority of cases—about 80 per cent. Our erythema dose represents 800 r as calibrated by a Wulf ionometer. The operating factors for the roentgen equipment are repeatedly checked as well as controlled by a constant reading of an ionization chamber.

With 1 to 2 mm. of copper and 200 kv., the so-called erythema approximates the time and intensity of the skin reactions seen with radium filtrations approximating 1 to 2 mm. of platinum. This quality of radiation will produce a delayed skin reaction or erythema appearing as a faint redness or blanching at about the twenty-first day and showing a decided progressive intensity during the succeeding ten to fourteen days, and rapidly fading to a deep bronzing of the skin at the end of a month.

The reaction caused on the skin and in the tumor apparently depends not only on the amount of energy absorbed by the tissues, but upon the particular wave

\* The application of physical factors to the skin reactions from the short wave length roentgen rays and gamma rays of radium will be submitted in detail in a separate publication.



lengths of the radiation. Russ and Scott<sup>28</sup> showed that if the skin of a rat was exposed to a beam of roentgen rays limited to wave lengths ranging from 0.45 to 0.30 Å, a definite change subsequently occurred in the hair and skin, with a progressive increase of this reaction as the dose was increased. When the wave length was diminished to 0.168 Å, much the same effects were produced, but not until six times as much energy had been absorbed. Similar phenomena were observed when tumors were exposed (Jensen's rat sarcoma), but to cause the same effect with two groups of wave lengths only 2.6 times as much energy of the short wave length had to be absorbed. Russ found that when the wave length is shortened to about 0.1 Å, only 0.75 of the permanent depilation dose is needed to kill the tumor cells. He concluded that it must be more satisfactory to use short wave length radiation for subcutaneous growths, not only because of their greater penetrating power but also because of the change in the right direction of the differential factor.

During the past year much of the treatment at the Philadelphia General Hospital involved heavy filtrations and in many instances combinations of different qualities of rays, both radium and roentgen rays. For economy lead is used for the radium pack filters as well as other surface applications when heavy filtration is deemed advisable.\* The glass capillary tubes filled with radon are delivered to the department in silver tubes of 0.5 mm. wall thickness. These are inserted into lead capsules of 3 mm. wall thickness. The densities of these metal filters are approximately equivalent to 2 mm. of platinum or gold. With this filtration, 100 mc., plaque area 10 x 15 cm., 4 cm. distance, will produce an erythema in about 144 consecutive hours of irradiation, or 15,000 mc-hr. This total skin dose will produce a mild erythema in about twenty-one days and fade to a

bronzing of the skin in another 21 days. The skin toleration is much greater for the short wave length rays, particularly when the treatments are divided over a period of four to six weeks.

A rough estimate of the time difference is apparent when we compare the above dose which is a filtration equivalent to 2 mm. of platinum to the dose of 6,000 mc-hr. when 2 mm. of brass is used as a filter for the same area and distance. Approximately 60 per cent greater intensity is attained with the heavier filter. The density of 2 mm. of brass is 17; the atomic weight of 0.5 mm. silver, 0.25 mm. copper, and 3 mm. of lead is 40.45; this makes the ratio about 2.4 to 1. The 60 per cent increase in time is proportional to our ionization measurements. When the treatments are divided over a period of four to six weeks the skin will tolerate about 2.5 times the intensities that may be given with the usual filtrations of 2 mm. of brass.

For example: All cases of intraoral cancer are routinely given a total of 30,000 mc-hr. of gamma rays to both sides of the neck, divided into 4 or 6 applications of forty-eight hours each with one or two day intervals, according to the condition of the patient. If gland involvement is present at the start of treatment, 8 forty-eight hour packs (4 for each side of neck) are given within four to six weeks. This means a prolonged irradiation over a period of 384 hours, or a total dose of approximately 40,000 mc-hr. of irradiation to both sides of the neck. Occasionally treatments are extended beyond six to eight weeks in advanced cases. As much as 30,000 mc-hr. has been given to one side of the neck, making a total irradiation of 60,000 mc-hr. to both sides of the neck.

The routine pack contains ten radium points, 10 x 15 cm., 4 cm. distance, filter 0.5 mm. of silver and 3.0 mm. of lead. The capsules are fixed in position on a plate of copper 0.25 mm. thick. This total filtration is equivalent to the value of 2 mm. of platinum.

Divided treatment over this period of

\* The densities of the common radium filters: brass 8.5; copper 8.9; silver 10.5; platinum 19.3; lead 11.0; gold 21.4; 0.5 mm. of silver and 3 mm. of lead are approximately equivalent to 2 mm. of platinum or gold.



time to the estimation of the time appearance of an erythema difficult. From the start of the treatment, the first skin reaction or blanching is usually seen about the fifth week. This frequently progresses to desquamation but practically always disappears in ten to fourteen days, with marked bronzing and pigmentation.

The skin is decidedly more tolerant of gamma radiation (filtrations equivalent to 2 mm. of platinum) because frequently treatments have been carried on over periods of eight and ten weeks with total doses ranging from 60,000 to 70,000 mc-hr. about the neck and pelvic regions without any appreciable skin reaction.

The time factor of our high voltage technique, for an erythema, with 200 kv., 0.5 mm. of copper, 2 mm. of aluminum, 50 cm. distance, field 20 cm. sq., is 400 ma-min. (water-cooled tube mechanically rectified equipment). This represents 800 r. A treatment is controlled throughout by a constant reading of an ionization chamber<sup>30</sup> fixed to the tube stand and immediately in the central beam of the rays. The skin erythema dose increases for our equipment as follows: 0.5 mm. Cu + 2.0 mm. Al, s. e. d. = 400 ma-min.; 1 mm. Cu + 2 mm. Al, s. e. d. = 600 ma-min.; 1.5 mm. Cu + 2.0 mm. Al, s. e. d. = 706 ma-min., and 2 mm. Cu + 2 mm. Al = 950 ma-min.

As the filtration progressively increases above 0.5 mm. of copper, the ionization measurements become difficult and uncertain to interpret. Holthusen<sup>12</sup> found comparative measurements of roentgen rays of different wave lengths difficult and impractical in the light of our present knowledge, because of the heterogenous mixtures of radiations of varying hardness.

The erythema value or skin tolerance dose for various combinations of roentgen-ray filtrations of copper, 0.24 mm. to 2.0 mm., have been controlled by observations of several thousand doses. This value has likewise been checked for the gamma radium pack treatments (filter, 2 mm. platinum) on more than 300 cases.

In order to establish some working basis

to further improve end-results of the so-called advanced cancers, an attempt was made to study the limit of skin tolerance for different qualities of roentgen rays, with 0.5, 1.0, 1.5 and 2.0 mm. of copper, and the combination of these factors with gamma radium rays (filter, 2 mm. platinum).

Every case of advanced cancer that was physically fit to stand intensive irradiation was routinely treated.

All intraoral cancers with metastasis, and all cases of cervix, rectal, and prostatic cancer received gamma radium pack treatments in conjunction with roentgen rays (200 kv. and 0.5 mm. copper).

All ambulatory mouth cases were routinely given a combination of roentgen-ray wave lengths, with 0.5, 1.0, 1.5 mm. and sometimes 2 mm. of copper filtration through the same skin ports.

Experience has shown that large doses of radium and roentgen rays combined on the same skin area can be administered without serious skin damage. Quimby<sup>24</sup> determined the erythema value of "soft" and "hard" radium rays for a single treatment. (Filters: (a) 0.16 mm. of brass and 1.2 mm. of rubber; (b) 0.5 mm. of silver, 1 mm. of brass and 2.4 mm. of rubber). This investigation revealed that a radiation dose estimated by the erythema effect, required two-thirds of a dose of "soft" radiation to be followed immediately by two-thirds of a dose of "hard" radiation, or vice versa, in order to produce the same erythema as one full dose of either.

Quimby and Pack<sup>25</sup> further elaborated this study by combining roentgen and radium rays to the same field at the same sitting.

They found that a combined dose of 134 per cent was necessary to produce a threshold erythema in 80 per cent of the cases. The factors were: roentgen rays (kenotron) 165 kv., 3 ma., 0.4 mm. Cu, 1 mm. Al at 50 cm. distance, area 3 × 3 cm.; radium, 0.5 mm. of platinum, wood and rubber at 1 cm. distance. Region, anterior surface of the thigh. No physical



means of measuring radiations were employed by Quimby and Pack because it has not yet been shown that physical reactions are proportional to ionization, or to any other physical phenomenon over the range of radiations considered.

It seemed reasonable and safe to first determine the erythema or skin tolerance dose of different combinations of wave lengths on the basis of preliminary skin tests. This information was then carried through an experience that embraced the routine treatment procedures for most of the advanced intraoral and pelvic cancers, with the following conclusions:

We found that a total of 130 per cent skin erythema dose could be administered at one sitting, if the roentgen-ray qualities from 0.5 and 1.0 mm. of copper, 200 kv. (800 r=s. E. D.) were employed in equal amounts of 65 per cent each (area  $10 \times 15$  cm.).

The skin toleration was decidedly increased with copper filtrations above 1 mm., i.e., 1.5 mm. and 2.0 mm. of copper (area  $10 \times 15$  cm.).

We also found that a total of 140 per cent s. E. D. could be given at one sitting with combinations of roentgen-ray qualities from 0.5 mm. of copper and 1.5 or 2 mm. of copper and 200 kv., with equal amounts of each wave length (area  $10 \times 15$  cm.).

Because of our multiple field technique<sup>31</sup> and the protracted course of treatments extending over periods of four to six weeks with multiple divided doses, a saturation of the depth dose at the tumor site could be maintained with little or no appreciable reaction on the skin. Saturation curves<sup>22,31</sup> facilitate dose calculations and tend to further a systematic routine of planning treatments with some relative uniformity.

In a previous communication,<sup>31</sup> we showed many combinations of skin erythema doses that during three to four weeks would achieve total intensities of 200 per cent in the tumor area without exceeding a total of 150 per cent on the skin by the four field technique in pelvic

cases. This procedure had a saturation of 100 per cent in the tumor without exceeding a saturation of 75 per cent on the skin.

The clinical observations on several thousand doses according to this routine indicates a procedure that will admit of greater quantities of radiation with preservation of the skin and is readily applicable to the depleted physical conditions of advanced cancer cases.

In 173 cases a combination of gamma radiation packs ( $10 \times 15$  cm., 4 cm. distance, 0.5 mm. silver and 3 mm. lead) was used with roentgen rays (200 kv. and 0.5 mm. copper). During four weeks six 20 per cent doses of roentgen rays and four gamma radium packs of 5000 mc-hr. each could be administered to a given skin portal. A total of 20,000 mc-hr. with these factors is equivalent to 125 per cent of an erythema dose. The combination of roentgen and radium rays of these qualities permits a total of 225 per cent of an erythema dose in a period of four weeks to a given skin portal.

The divided dose technique is particularly adaptable to the advanced cancer case, not only for the benefits of the prolonged irradiation during the different stages of cell division, but because these patients are potentially sick, and the dangers of systemic shock must be guarded against by the observations of an experienced radiologist.

The clinical results in 154 cases of advanced cancer have been carefully noted over a period of ten months. The anatomical regions involved were as follows:

Intraoral (lip, cheek, tongue, tonsil, floor mouth) (with bilateral cervical metastasis, 37).....	52
Breast, inoperable.....	7
Breast, inoperable with bone metastasis.....	4
Bladder.....	7
Cervix, inoperable—extensive pelvic infiltration.....	47
Larynx with cervical gland metastasis.....	11
Prostate.....	6



Bladder cancer metastasis of ...	30
Rectal cancer metastasis of ...	17
Total	154

Only clinical impressions of improved results can be estimated in an evaluation of these late cases, with an observation that covers only ten months. The importance of the work to date has been the accumulation of clinical data and the development of techniques that permit the administration of greater intensities of radiation to the extent of two to three times the quantities we have previously used routinely.

The grade of malignancy according to cellular differentiation could not be obtained in all cases, because 67 cases had biopsies done in other institutions and were not so graded. Eighty-one cases had previous treatment elsewhere. All cases were frank late or advanced conditions.

The criteria for estimating "improvement" were the maintenance of good health and strength in already advanced stages of the disease, and a reduction or disappearance of the tumor mass or metastatic glands or both.

The reduction of metastatic cervical glands in intraoral cancer was decidedly uniformly better. In 5 cases the glands of both sides of the neck completely disappeared. In 3 of these cases there is evidence of recurrence. In 17 cases the bilateral gland reduction was incomplete, but so pronounced that it must be weighed an achievement in the light of the extent of the original involvement. In 30 cases the improvement was not sufficient to regard as significant. Ten months' observation is not sufficient to make comparative estimates of the degree of fibrosis as compared to this process with longer wave length radiations. In 3 cases with marked fibrosis after prolonged irradiation before admission to this service, there was a decided further reduction in the size of the masses.

Of 11 laryngeal cases with bilateral gland involvement, one case with exten-

sive involvement showed complete recession of all palpable evidence of disease and almost complete disappearance of the intralaryngeal involvement. A progressive recurrence developed ten weeks after irradiation was discontinued. Three postoperative recurrences are apparently arrested. In 7 cases the treatment was insufficient due to complicating toxemia and weakness.

Some of the most intensive treatments given have been to the neck regions. In only a few instances was throat irritation or soreness noted.

Of 7 bladder cases, 5 were symptom-free after a single series of treatments. Equally good results have been observed with 200 kv. and 0.5 mm. of copper, but treatments invariably were followed by more tenesmus. Recurrence of bleeding and tenesmus eight to twelve months after apparently successful heavy irradiation frequently meets with little or no response to further irradiation. In 2 such cases, combined gamma radium packs using 125 per cent S.E.D. (2 mm. platinum filter), applied to the anterior abdomen, plus 120 per cent S.E.D. of roentgen rays with 200 kv., 0.5 mm. copper and a four field technique (the two anterior fields representing the single skin port for the radium pack) were given in four weeks. The clinical results were comparable to the 5 cases with a good response after the first series of treatments.

The results in the breast, rectal and prostatic cases are difficult to evaluate. In some of these cases treatments have been carried on intermittently over periods of five and six months. In some instances totals of 400 per cent of an erythema dose have been attained on the same skin portal without deleterious effects. Equally good physical conditions have been maintained in other cases of like involvement with the generally used high voltage technique. We anticipate that a subsequent report on the longevity cycle of these cases will show the advantage of the greater intensities of radiation given.



Of the 47 advanced cervical cancers with widespread pelvic involvement, only 23 cases are living after ten months. In 11 cases the improvement was so marked that there is little question in our minds of the superior benefits from combined wave length radiation. One case with a rectovaginal fistula and marked pelvic infiltration and cachexia, is clinically free of disease—now four months. Five cases have remained stationary as to the extent of involvement and general health. Six cases have failed rapidly.

These observations of improvement are significant even though the results are transitory and embrace a period of time less than a year. The combination of various short wave length roentgen rays (200 kv.) in conjunction with gamma radium rays insures the delivery of greater intensities of radiation to the tumor site, and particularly with multiple skin portals, than any other technique in our experience.

If there is no selectivity of certain types of radiation to certain cancers then radiation therapy has manifestly reached its limitations for good. Unless radiologists are to fall short of accomplishing a good proportion of success in the more advanced types of cancer cases still in good physical condition, then some concerted effort to build up still greater intensities of radiation in the tumor areas, and preserve the integrity of the normal tissues must be fostered and developed.

#### SUMMARY AND CONCLUSIONS

1. Clinical experience indicates that certain cancers are radiosensitive and radio-resistant.
2. Highly cellular cancers are extremely malignant and also very radiosensitive.
3. The future success of radiation therapy of advanced cancer must depend upon

the development of some means that will permit the administration of greater quantities of radiation than are generally used and still preserve the integrity of the normal tissues as well as the general health of the patient.

4. The "skin erythema dose" or skin tolerance should be standardized by systematic and repeated ionization controls. A constant reading "ionization system" is ideal for this purpose. Each radiologist should know the milliamperere-minutes dose equivalent to a given number of roentgens for his particular machine. We have found 800 r to be a safe erythema dose from an experience of more than 15,000 doses of roentgen rays.

5. Prolonged irradiations, according to Regaud, are indicated by the improved radiation effects at varying stages of cell division as observed experimentally and clinically.

6. Clinical results point to a selective action of gamma radium rays (with filtration equivalent to 2 mm. of platinum).

7. Combinations of different short wave lengths of roentgen rays (200,000 volts; filtrations: 0.5, 1.0, 1.5, and 2.0 mm. of copper or zinc), or in conjunction with gamma radium packs to the same skin area will increase the skin tolerance for radiations 30 to 40 per cent.

8. The combination of the shorter wave length radium and roentgen rays with a multiple skin port technique, offers a safe approach to a method of administering two to three times the depth intensities of radiations that are generally obtained, without deleterious effects to the skin or the general well-being of the patient.

9. Clinical impressions justify the inference of improved end-results in advanced cancer by the systematic application of combined short wave length radium and roentgen rays.

#### REFERENCES

1. ALBERTI, W., and POLITZER, G. Experimental-biologische Vorstudien zur Krebstherapie. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1924, 32, 56-64.
2. BRODERS, A. C. Squamous-cell epithelioma of the skin. *Ann. Surg.*, 1921, 73, 141. Squamous-cell epithelioma of the lip. *J. Am. M. Ass.*, 1920, 74, 656. Epithelioma of cavities and



- internal organs of the head and neck. *Arch. Surg.*, 1925, 11, 43-73.
3. CANTI, R. G. Effect of irradiation on tissues. *St. Barth. Hosp. Rep.*, 1927, 60, 57-72.
4. CHAMBERLAIN, W. E. Discussion of paper by Holthusen. *Radiology*, 1929, 12, 43.
5. DOGNON, A. La mesure et l'action biologique des rayons x de différentes longueurs d'onde. Thèse fac. de méd. Strasbourg, 1925. *Arch. de phys. biol.*, 1924-25, 4, 87-182.
6. EWING, J. Radiosensitivity. *Radiology*, 1929, 13, 313-318.
7. FAILLA, G. Discussion of paper by Wood. See Ref. 32.
8. FORSELL, G., BERVEN, E., HEYMAN, J., and THORAEUS, R. Report of Cases Radiologically Treated at the Radiumhemmet. Special publication. Norstedt & Soner, Stockholm, 1929.
9. GREENOUGH, R. B. Varying degrees of malignancy in cancer of the breast. *J. Cancer Research*, 1925, 9, 453-463.
10. HEALY, W. P., and CUTLER, M. Relation between structure and prognosis in cervical carcinoma under radiation treatment. *Am. J. Obst. & Gynec.*, 1928, 16, 15-28.
11. HERTWIG, G. Das Radiumexperiment in der Biologie. *Strahlentherapie*, 1920, 11, 821-850.
12. HOLTHUSEN, H. The present status of physical methods of dose measurements. *Strahlentherapie*, 1926, 22, 1-37.
13. HOLTHUSEN, H. Discussion. *Radiology*, 1928, 11, 407.
14. HOLTHUSEN, H. The biological aspects of roentgen therapy. *Radiology*, 1929, 12, 35-44.
15. LACASSAGNE, A. The direct and indirect action of radiation on cancer tissues. *Radiology*, 1928, 11, 393-402.
16. LACASSAGNE, A. The importance of filtration and superiority of pure gamma radiation in the radiotherapy of malignant tumors. *Radiology*, 1929, 13, 95-102.
17. MARKOVITS, E. Ueber die Einwirkung des Mesothoriums auf Einzellige. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1921-1922, 28, 22-26.
18. MOHR, O. L. Mikroskopische Untersuchungen zu Experimenten über den Einfluss der Radiumstrahlen und der Kälte Wirkung auf die Chromatinreifung und das Heterochromosom bei *Dactylus verrucivorus* (♂). *Arch. f. mikr. Anat.*, 1919, 92, 300-368.
19. NATHER, K., and SCHINZ, H. R. Tierexperimentelle Röntgenstudien zum Krebsproblem. I. Gibt es eine Reizdosis bei malignen Tumoren? *Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 1923, 36, 620-660.
20. PFAHLER, G. E. Gamma radiation in mouth cancer. Cancer Conference, London, July, 1928. Improved technique for the use of highly filtered gamma rays in the treatment of cancer of the mouth. *AM. J. ROENTGENOL. & RAD. THERAPY*, June, 1930, 23, 633-638.
21. PFAHLER, G. E., and WIDMANN, B. P. A statistical study of radiation therapy in 801 cases of cancer of the breast. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1925, 14, 550-562.
22. PFAHLER, G. E., and WIDMANN, B. P. Further observations on the use of the saturation method of radiation therapy in deep-seated malignant disease, with some statistics. *Radiology*, 1928, 11, 181-190.
23. PFAHLER, G. E., and WIDMANN, B. P. Statistical analysis of the radiation treatment of cancer of the breast on the basis of the saturation technique in 412 cases (1920-1928). *AM. J. ROENTGENOL. & RAD. THERAPY*, 1929, 21, 546-555.
24. QUIMBY, E. H. The skin erythema dose with a combination of two types of radiation. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1927, 17, 621-625.
25. QUIMBY, E. H., and PACK, G. T. The skin erythema for combinations of gamma and roentgen rays. *Radiology*, 1929, 13, 306-312.
26. REGAUD, CL. Radium therapy of cancer at the Radium Institute of Paris. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1929, 21, 1-24.
27. RUSS, S. On the effects of x-rays of different wave-lengths upon some animal tissues. Proof of differential action. *Proc. Roy. Soc. Lond.*, 1923, Series B, 95, 131-142.
28. RUSS, S., and SCOTT, G. M. The differential action of x-rays and gamma rays upon some living tissues. *Brit. J. Radiol.*, 1929, 2, 301-306.
29. SCHMITZ, H., HUEPER, W., and ARNOLD, L. The significance of the histological "malignancy index" for prognosis and treatment of carcinomata of the cervix uteri. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1926, 16, 30-42.
30. WEATHERWAX, J. L. A comparative study of dosage technique in radiation therapy. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1927, 18, 346-355.
31. WEATHERWAX, J. L., and WIDMANN, B. P. Physical factors in radiation therapy and their clinical application. *Radiology*, 1929, 12, 297-308.
32. WOOD, F. C. Effect on tumors of radiation of different wave lengths. *AM. J. ROENTGENOL. & RAD. THERAPY*, 1924, 12, 474-482.
33. WOOD, F. C. Cancer biology and radiation. *Radiology*, 1928, 11, 388-392.
34. WOOD, F. C. A biological ionization chamber. *Radiology*, 1929, 12, 461-471.



# A ROENTGEN SIGN OF PLUMBISM

## THE LEAD LINE IN GROWING BONE\*

By EDWARD C. VOGT, M.D.

BOSTON, MASSACHUSETTS

GRACE S., aged two years, was admitted to the Children's Hospital on Aug. 6, 1929, on account of vomiting which started two days before entry, preceded by a generalized convulsion. The history was important only in that ever since ten months of age the parents were unable to prevent her from eating all kinds of foreign material including paint from the furniture. Physical examination was quite negative except for a moderate pallor and rachitic beading of the ribs. Blood studies showed a moderate anemia but no definite stippling. The clinical diagnosis was "probable lead poisoning and rickets."

Roentgenograms of the extremities showed marked flaring of the ends of the long bones with an unusually dense zone at the ends of the diaphyses (Fig. 1). The question arose as to whether this density was due to healing rickets alone or whether lead poisoning was in part accountable. These findings were dis-

cussed with Dr. Louis Diamond, who had referred the patient and it was agreed that he would send any subsequent cases suspected of plumbism for roentgen study.

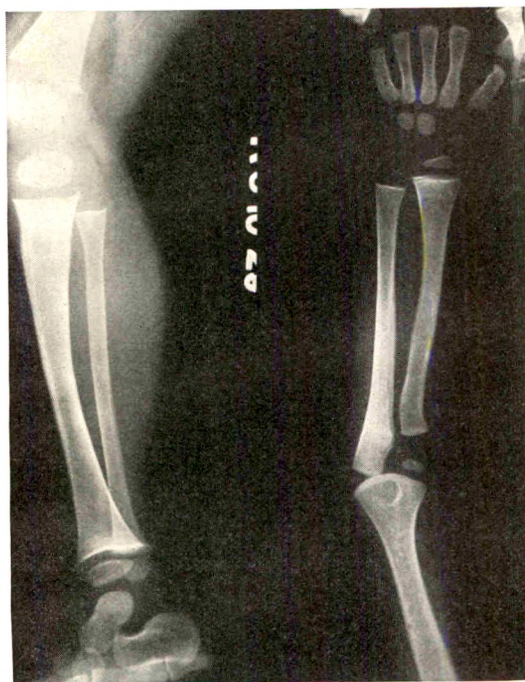


FIG. 1. Lead poisoning in a rachitic child.

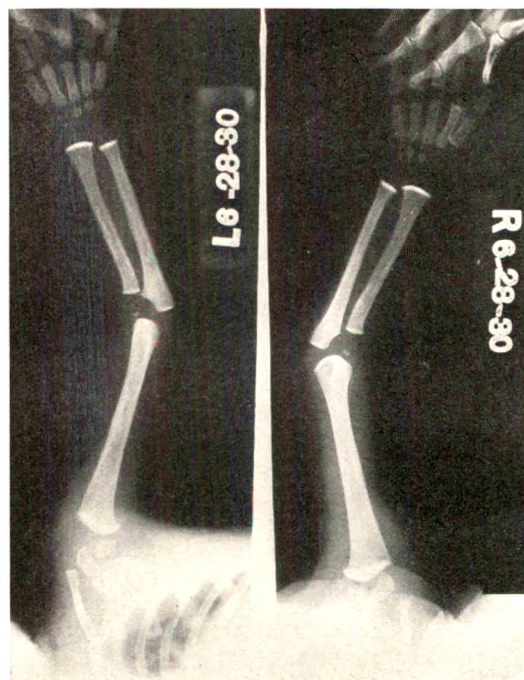


FIG. 2. Roentgenograms of the case reported with lead-calcium determinations.

The next case of clinical lead poisoning, R. G., was a boy two years and four months of age, admitted Sept. 6, 1929, with a history of paint eating for over a year. During that time he had many vomiting attacks, associated with abdominal colic and constipation. On examination he was pale and irritable but seemed drowsy when undisturbed. Blood studies showed a moderate secondary anemia and many stippled cells. The spinal fluid was clear showing no increased pressure or cells but there was a definitely increased globulin content.

Roentgenograms of the extremities showed a broad zone of increased density at the ends

\* From the Roentgenological Department of the Infant's and Children's Hospitals, Boston, Mass.



of the long bones which shaded off gradually into the adjacent cortex for approximately 0.5 cm.

These findings seemed to warrant further investigation so the hospital diagnostic files were then consulted and 4 recorded cases of lead poisoning found on which roentgenograms of the chest or extremities had been obtained. Three of these showed the dense zone at the ends of the long bones distinctly, but had been passed over previously as probably indicating healed rickets. The other one in which there was some question as to the correct clinical diagnosis, did not show anything definitely abnormal.

Our faith in the significance of these findings was very much stimulated by a paper read by Dr. E. A. Park, before the Eastern Society for Pediatric Research, May 3, 1930. He has observed this dense line in 6 cases and thinks it may be the

most constant sign of lead poisoning in children.<sup>3</sup>

During the past year 8 cases of clinical lead poisoning have been admitted to the Infant's and Children's Hospitals, all of whom have had films of the extremities and chest while some of them had examinations of the entire skeleton. A constant finding was the dense zone at the growing edges of the bones which was usually evident

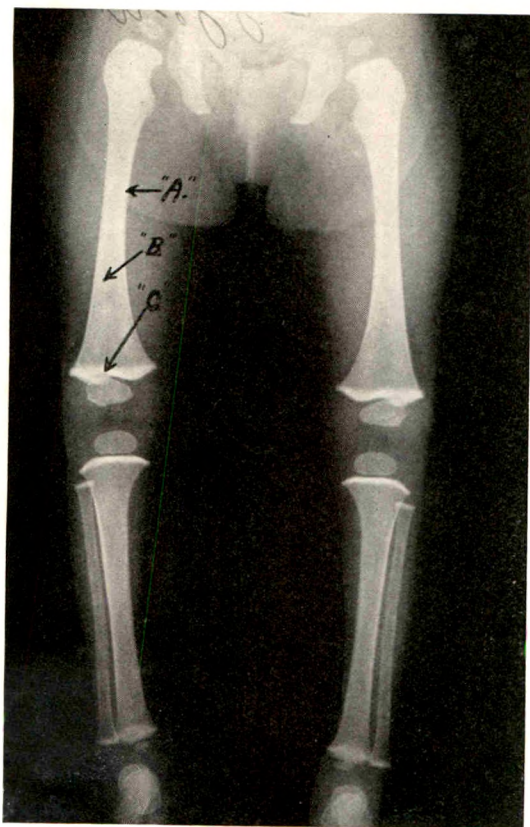


FIG. 3. Same as Figure 2.

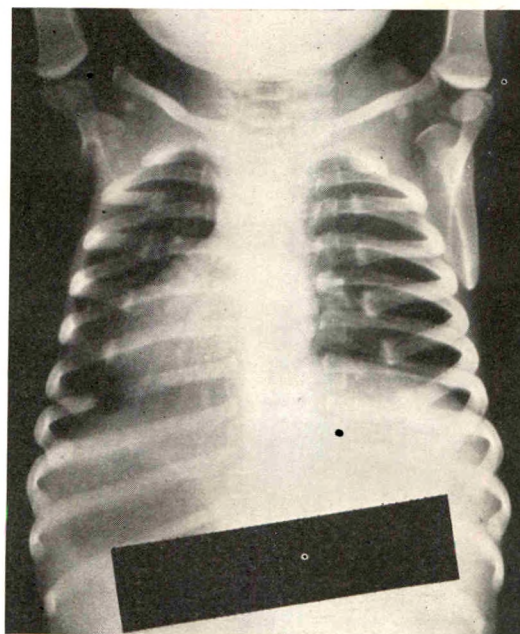


FIG. 4. Same as Figure 2.

adjacent to any epiphysis but most marked at the ends of the long bones of the extremities and at the anterior ends of the ribs.

A case of more than usual interest was an infant girl, J. W., seven months of age admitted June 27, 1930, with the chief complaint of vomiting for three weeks. She had been breast fed till six months of age and then put on a whole milk formula. She had received orange juice since five months of age and viosterol for the last two weeks. Nothing unusual was revealed on physical examination, but there were many stippled cells in the blood smear. Spinal fluid was obtained under increased pressure and contained increased globulin and 20 cells.

On the roentgenograms there was a very dense band at the ends of the long bones, which



when considered with the clinical picture was obviously due to lead poisoning. However no source of lead could be discovered and the mother denied using lead nipple shields which was the case with another infant in the ward



FIG. 5. A case of lead poisoning four months after treatment was instituted. Note double lines of increased density.

at the same time. Treatment was started but the baby did poorly and died on the third day in the hospital.

At necropsy the brain was quite edematous and death was ascribed to lead encephalitis. The right femur was removed and sent to the laboratory of Dr. Joseph C. Aub for chemical analysis. Sections of this bone were taken from three different areas for lead and calcium determinations. The results are listed in Table I.

As shown by Table I the lead was deposited in inverse ratio to the calcium. The zones of greatest density on the roentgenograms contained less calcium, but 4

RESULTS OF ANALYSIS OF BONE				
Area	Weight of bone	Total lead	Lead per g.	Calcium per g. bone
Cortex (A)	3.605 gm.	0.442 mg.	0.12 mg.	0.202 gm.
Medullary spicules (B)	2.860 gm.	0.510 mg.	0.178 mg.	0.133 gm.
Dense areas from ends of bone (C)	3.652 gm.	1.923 mg.	0.527 mg.	0.124 gm.

times as much lead as the cortex. Therefore, it seems evident that the opacity was due to lead.

#### DISCUSSION

Dr. Joseph C. Aub and his coworkers<sup>1</sup> have shown the close relationship between calcium and lead metabolism. In the body these elements are influenced by the same factors, and storage is for the most part in the skeleton. As might be expected, precipitation is more rapid in the growing ends of the bones.

Since calcium and lead are both relatively opaque to the roentgen ray and since the course of deposition runs practically parallel, recognition may at times prove difficult. This is particularly true in children with recently healed rickets where calcium had been laid down rapidly in the growing areas. Although in most cases of plumbism the dense zone is heavier than that seen in any other condition, still the milder case may not be so easy to differentiate.

Pirie<sup>4</sup> has recently called attention to a band of increased density at the ends of the long bones in the early stages of the condition called "marble bones." However this is a rare disease and should seldom cause confusion, particularly if considered with the history and clinical evidence.

The line in scurvy is narrower than that in lead poisoning and with the other characteristic changes it is easy to dis-



...e, white, aged twenty-eight, ... to the Mt. Sinai Hospital on ... 1930, with cough, expectoration, loss of weight and extreme fatigue. These symptoms were of six months' duration. The expectoration had increased greatly during the past three months and had become purulent. Three weeks before admission, he developed fever, marked prostration, anorexia and profuse perspiration. He was somewhat hoarse.

The patient had scarlet fever in childhood and a chancre fourteen years ago when he was fourteen. He is married and has three children, all living and well. His wife has had no miscarriages.

Examination by Dr. A. I. Rubenstone revealed a poorly nourished man with flushed features and a constant cough. The left pupil was smaller than the right and irregular. Both, however, reacted equally to light and accommodation. The pharynx was markedly congested and the tonsils badly diseased. There was diminished expansion in the left chest, dullness from the spine of the scapula downward and absent respirations over this area. Bronchovesicular breathing and bronchial râles after coughing were present in the left upper

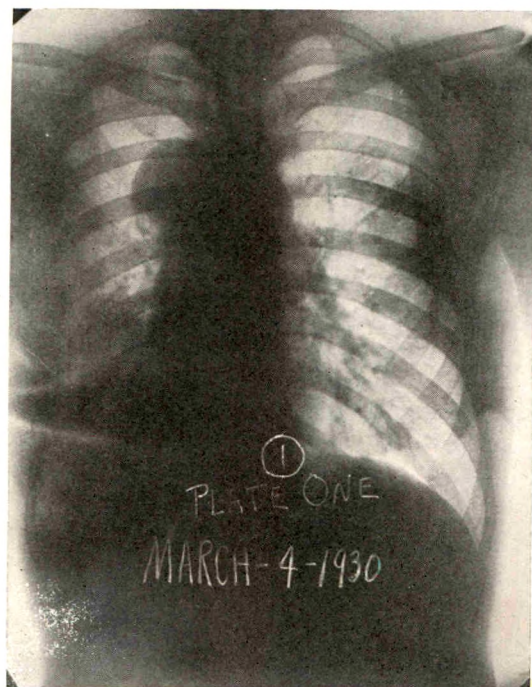


FIG. 1.

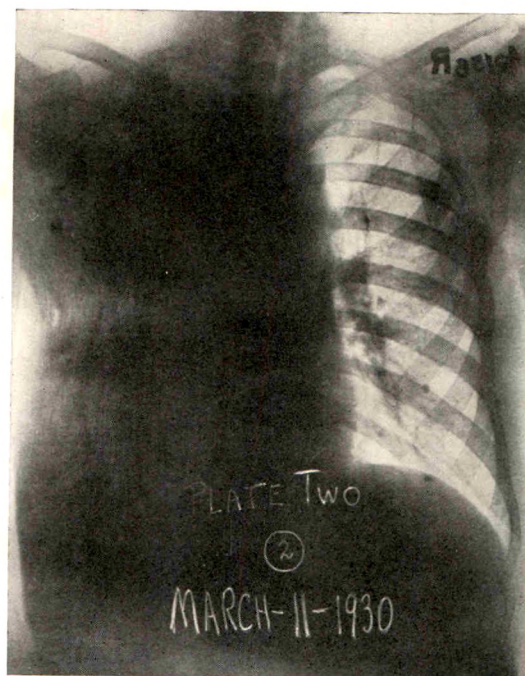


FIG. 2.

lobe. The right lung was emphysematous. The heart was not enlarged. Blood pressure, 110/68. The eye grounds were negative. While the larynx was markedly congested there was no paralysis of or pressure upon the vocal cords. Temperature was 104° F.; pulse, normal. Urine showed a marked cloud of albumin but was otherwise normal. The blood showed a mild anemia, with moderate leucocytosis—11,500, with 75 per cent polymorphonuclears. Blood chemistry was negative; Wassermann reaction strongly positive. Study of the sputum was negative for tubercle bacilli, spirilli, and parasites. Blood culture was negative. The electrocardiogram showed no abnormality.

The roentgen examination (Fig. 1) made on Feb. 22, the day after admission, showed a dilatation of the horizontal arch of the aorta, chiefly to the left, with a small heart slightly retracted to the left. Both diaphragms were normal. The aneurysmal phthisis of the lower left lobe was interpreted as infected atelectatic patches. The left chest was somewhat smaller than the right and the left diaphragm was slightly elevated, suggesting atelectasis. No pulsation was present in the aneurysm.

A few days after admission the patient developed a septic temperature and expectorated large quantities of pus. On the sixth day he was



suddenly awakened from sleep with severe pain in the left chest and shortness of breath, continuing for one-half hour. Temperature was 103° F. with pulse of 120 and rapid respirations.

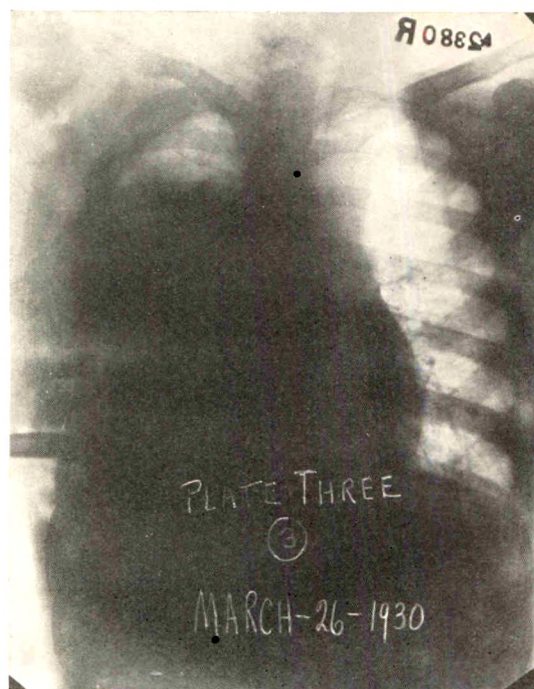


Fig. 3.

Clinically this was interpreted as a rupture of the lung abscess into the pleurae with empyema. Thoracentesis at this time removed 20 c.c. of a brownish pus which revealed hemolytic streptococci. The blood picture at this time showed a white count of 24,000, with 90 per cent polymorphonuclears. Roentgen study at this time (March 11) revealed a pleural effusion, atelectasis with some retraction of the heart to the left, and of added interest, the complete obliteration of the previously noted aneurysm (Fig. 2). Had this patient first been studied roentgenologically at this time, the diagnosis of aneurysm with lung abscess could not have been made under any circumstance.

Three days later (March 14) a thoracotomy was performed. Lung collapse was found and dense adhesions between the visceral and parietal pleura. A tube was inserted for drainage. However, even though drainage was free the patient still continued his septic fever. Transfusions were resorted to, but no improvement was noted. Four days later a resection

of the septic area was performed. At this time the patient was clearly improved. (Fig. 3) showed that the heart had returned to its normal position but the abscessed lung still appeared cloudy and it was not possible to see the aneurysm. In spite of frequent drainage and stimulation, the patient died on five weeks after admission.

Autopsy by Dr. Davidson revealed a not unduly sized heart with a chronic fibrinous pericarditis and 270 c.c. of a thick, yellow, flocculent, purulent effusion. The first 5 cm. of the aorta showed numerous flat elevations measuring from 1 to 5 mm. in diameter, yellowish in color. The intima showed patches of ulceration. Five centimeters above the aortic ostium there was a fusiform dilatation involving the upper part of the ascending aorta and the horizontal arch. Within this fusiform aneurysm were two smaller saccular aneurysms. The one to the right was oval, 6×5 cm. and filled with a thrombus, which formed a complete cast of the aneurysm. The thrombus was organized and consisted of many distinct layers. After removal of this thrombus, it left an opening 3 cm. in diameter, abutting the trachea and left bronchus.

The second saccular aneurysm lay to the left. This was smaller and protruded into and was adherent to the apex of the left lung. The circumference of the aorta in the aneurysmal zone was 15 cm. The descending thoracic aorta measured 4.5 cm. in circumference and showed numerous flat yellow elevations. The trachea and left bronchus were congested and bulging due to pressure of the aneurysm.

In the left lung the pleural cavity was completely obliterated by dense adhesions. The upper lobe showed numerous small cavities. The lower lobe showed a cavity 8 cm. in diameter. The entire lung structure was atelectatic. The right lung was normal. The remaining viscera showed nothing of particular interest.

Cases of this kind are not rare, but it seems fitting occasionally to call specific attention to them. This was the case of a young man of twenty-eight, with syphilis of fourteen years' duration. He was married and the father of three healthy children. He developed a fusiform aneurysm of the

aortic aneurysm, of dense  
non-pulsatile character, through  
the left bronchus and trachea  
by the laminated thrombus. Pressure on  
the left bronchus, however, caused small  
atelectatic patches which became infected,  
causing lung abscess, pleurisy and death.

Roentgenologists are aware of the fact, of  
which most clinicians are not, that under  
certain conditions, aneurysms do not pul-  
sate and, with associated pulmonary or  
pleural complications, may not be demon-  
strable, even if of very large size. Had this  
case been first studied after March 11  
(Fig. 2) no diagnosis could have been ar-  
rived at.





# THE AMERICAN JOURNAL OF ROENTGEN RAY AND RADIUM THERAPY

*Editor:* LAWRENCE REYNOLDS, M.D.

*Editorial Board:* A. C. CHRISTIE, M.D.

E. H. SKINNER, M.D.

WILLIAM DUANE, PH.D.

*Advisory Board for Pathology:* JAMES EWING, M.D.

EUGENE OPIE, M.D.

A. S. WARTHIN, M.D.

*Collaborating Editors:* The Officers and Committee Members of the Societies of which this JOURNAL is the official organ, whose names appear on this page, are considered collaborating editors of this JOURNAL.

*Foreign Collaborators:* A. BÉCLÈRE, M.D., PARIS, GÖSTA FORSSELL, M.D., STOCKHOLM, G. F. HAENISCH, M.D., HAMBURG, R. LEDOUX-LEBARD, M.D., PARIS.

*Publisher:* CHARLES C. THOMAS, SPRINGFIELD, ILL.

*Issued Monthly. Subscription \$10.00 per year, \$11.00 in Canada and \$12.00 in foreign countries. Advertising rates submitted on application. Editorial office, 110 Professional Building, Detroit, Mich. Office of publication, 220 E. Monroe St., Springfield, Ill. Information of interest to all readers will be found on page iv.*

## Officers and Standing Committees

### THE AMERICAN ROENTGEN RAY SOCIETY

*President:* A. B. MOORE, Washington, D. C.;  
*President-Elect:* LEOPOLD JACHES, New York City;  
*1st Vice-President:* E. L. JENKINSON, Chicago, Ill.;  
*2d Vice-President:* E. P. PENDERGRASS, Philadelphia, Pa.;  
*Secretary:* JOHN T. MURPHY, 421 Michigan St., Toledo, Ohio; *Treasurer:* WILLIAM A. EVANS, 10 Peterboro St., Detroit, Mich.; *Librarian and Historian:* E. H. SKINNER, Kansas City, Mo.

*Executive Council:* L. R. SANTE, Chairman, 606 Missouri Bldg., St. Louis, Mo., F. M. HODGES, Richmond, Va., CHARLES A. WATERS, Baltimore, Md., A. B. MOORE, Washington, D. C., LEOPOLD JACHES, New York City, LAWRENCE REYNOLDS, Detroit, Mich., JOHN T. MURPHY, Toledo, Ohio, WILLIAM A. EVANS, Detroit, Mich.

*Committee on Laws and Public Policy:* B. R. KIRKLIN, Chairman, Rochester, Minn., FRED M. HODGES, Richmond, Va., WILLIAM E. CHAMBERLAIN, San Francisco, Calif.

*Committee on Safety and Standards:* P. M. HICKEY, Chairman, University Hospital, Ann Arbor, Mich., H. K. PANCOAST, Philadelphia, Pa., W. D. COOLIDGE, Schenectady, N. Y., A. U. DESJARDINS, Rochester, Minn., H. J. ULLMANN, Santa Barbara, Calif., B. H. NICHOLS, Cleveland, Ohio, G. E. RICHARDS, Toronto, Canada, R. R. NEWELL, San Francisco, Calif.

*Publication Committee:* WILLIAM A. EVANS, Chairman, Detroit, Mich., L. R. SANTE, St. Louis, Mo., F. M. HODGES, Richmond, Va.

*Leonard Prize Committee:* P. M. HICKEY, Chairman, Ann Arbor, Mich., W. B. BOWMAN, Los Angeles, Calif., A. C. CHRISTIE, Washington, D. C., W. A. EVANS, Detroit, Mich., G. W. GRIER, Pittsburgh, Pa., B. H. NICHOLS, Cleveland, Ohio, G. E. PFAHLER, Philadelphia, Pa.

*Tube Committee:* DAVID R. BOWEN, Chairman, Philadelphia, Pa., I. H. LOCKWOOD, Kansas City, Mo., E. C. ERNST, St. Louis, Mo., G. W. GRIER, Pittsburgh, Pa., E. A. POHLE, Madison, Wis.

*Member, National Research Council:* W. F. MANGES, Philadelphia, Pa.

*Delegate to Third International Congress, Paris,*

*July 27-31, 1931:* P. M. HICKEY, Ann Arbor, Mich.;  
Alternate, G. E. PFAHLER, Philadelphia, Pa.

*Editor:* LAWRENCE REYNOLDS, 110 Professional Building, Detroit, Mich.

*Editorial Board:* A. C. CHRISTIE, E. H. SKINNER, WM. DUANE.

*Advisory Board for Pathology:* JAMES EWING, EUGENE OPIE, ALDRED S. WARTHIN.

*Publisher:* CHARLES C. THOMAS, 220 East Monroe St., Springfield, Ill.

*Thirty-second Annual Meeting:* Atlantic City, N. J., September, 1931.

### THE AMERICAN RADIUM SOCIETY

*President:* H. J. ULLMANN, 1520 Chapala St., Santa Barbara, Calif.; *President-Elect:* SANFORD WITHERS, Denver, Colo.; *First Vice-President:* BURTON J. LEE, New York City; *Second Vice-President:* EDWARD H. SKINNER, Kansas City, Mo.; *Secretary:* G. W. GRIER, Jenkins Arcade, Pittsburgh, Pa.; *Treasurer:* ZOE A. JOHNSTON, Jenkins Arcade, Pittsburgh, Pa.

*Executive Committee:* CURTIS F. BURNAM, Chairman, 1418 Eutaw Place, Baltimore, Md., EDWIN C. ERNST, St. Louis, Mo., H. H. BOWING, Rochester, Minn.

*Program Committee:* SANFORD WITHERS, Chairman, 304 Republic Bldg., Denver, Colo., BURTON J. LEE, New York City, HENRY SCHMITZ, Chicago.

*Publication Committee:* EDWARD H. SKINNER, Chairman, 1532 Professional Bldg., Kansas City, Mo., HENRY SCHMITZ, Chicago, DOUGLAS QUICK, New York City.

*Research and Standardization Committee:* G. FAILLA, Chairman, Memorial Hospital, New York City, H. J. ULLMANN, Santa Barbara, Calif., R. B. GREENOUGH, Boston, Mass.

*Education and Publicity Committee:* SANFORD WITHERS, Chairman, 304 Republic Bldg., Denver, Colo., G. E. PFAHLER, Philadelphia, T. D. QUIGLEY, Omaha, Nebr.

*Sixteenth Annual Meeting:* Philadelphia, 1931.

*Committee on Arrangements:* G. E. PFAHLER, Chairman, 1321 Spruce St., Philadelphia, W. S. NEWCOMET, Philadelphia, H. K. PANCOAST, Philadelphia, W. H. SCHMIDT, Philadelphia, W. L. CLARK, Philadelphia.



# EDITORIALS

## THE EARLY DIAGNOSIS OF CARCINOMA OF THE STOMACH

CANCER of the stomach is the most common malignancy encountered. More than one-third of the cancers in men, and more than one-fifth in women occur in this organ. If this be true, then any method or combination of methods should be utilized in its early detection, and the most dependable diagnostic aid is the roentgen ray. With it the great majority of lesions of the stomach can be demonstrated, and it may be of tremendous importance in determining the operability of the lesion.

The classical roentgen sign of carcinoma of the stomach is a filling defect, and when the extraneous causes of filling defects such as pressure from the spleen or the transverse and splenic flexures of the colon are excluded, any persistent defect in the gastric outline must be regarded as malignant until proved otherwise.

In addition to the filling defect, one may observe changes in the size and position of the stomach, as well as alterations in the gastric peristalsis. The size of the stomach may be markedly reduced as compared with the normal. This is especially true of malignant lesions involving the midportion or cardiac end of the stomach. Rarely does carcinoma cause dilatation of the stomach unless it occurs at and early occludes the pyloric outlet. In such a case the stomach may be dilated considerably, though as a rule carcinomatous infiltration reduces the size of the stomach, and unless there is actual obstruction to the pyloric outlet the stomach empties its contents quite rapidly. This is an important differential point between a malignant and a benign lesion, since in ulcer cases the emptying time of the stomach is either

normal or delayed. • Not until the tumor has actually produced stenosis do we get obstructive symptoms in carcinoma. Then the gastric peristalsis may be exaggerated, both as regards its frequency and depth, and one may actually observe reverse peristalsis.

Fortunately for the patient as well as the roentgenologist, the majority of gastric carcinomata occur in the pyloric region, which makes their detection less difficult for the roentgenologist and their operative interference more favorable for the patient.

The cancers of the stomach which are missed in roentgen examinations, as a rule, are those occurring high up in the cardiac portion of the stomach, and unless particular care is taken in the examination of this region, a large-sized lesion may be easily overlooked, but carcinomata of the cardiac portion of the stomach represent a very small proportion of the total gastric lesions.

In spite of the clear-cut roentgenologic criteria laid down for the diagnosis of gastric carcinoma and the reasonable assurance one may have in stating positively the presence or absence of malignant disease of the stomach, there still remains much justification for the prevalent pessimism that obtains regarding the early diagnosis of gastric cancer, one important cause being the latent period of greater or lesser duration associated with this disease which makes an early diagnosis difficult.

Haudek,<sup>1</sup> in a recent excellent article, distinguishes four causes for delayed roentgen diagnosis. He groups these under: (1) the latent period; (2) delayed roentgen

<sup>1</sup> Haudek, Martin. X-rays in diagnosis of early carcinoma of the stomach. *Brit. J. Radiol.*, 1929, 2, 421-433.



examination; (3) faulty roentgen examination, and (4) the incompleteness of our present roentgen technique.

*The latent period*, that is, the time during which the gastric carcinoma remains symptom-free, is the prime factor which must be reckoned with, and Haudek suggests that some form of serum reaction may be of assistance in the diagnosis of these cases. This period of varying duration depends on the type and situation of the tumor. In carcinoma of the body of the stomach, especially with diffusely infiltrating growth, the local symptoms often occur so late that however prompt the operation there is rarely any chance of being able to perform a radical operation. The symptoms which lead to the earliest recognition of growth are pyloric stenosis and hemorrhage.

*The Delayed Roentgen Examination.* The intrinsic nature of the growth itself is too often the primary cause of the delay in the diagnosis. The symptom-complex produced by it is of such an indefinite nature that the patient seeks medical advice late in the disease. Too often the fault lies in the false sense of security engendered in the mind of the physician by the presence of "chronic dyspepsia," a dangerous catch-phrase in the man or woman of carcinoma age. A recent analysis of 365 cases of cancer of the stomach made by Saltzstein and Sandweiss<sup>1</sup> illustrates the point in question. The first symptoms given in 300 cases were studied. The analysis of these cases revealed the fact that histories of patients with cancer of the stomach can easily be divided into those which indicate a previous indigestion of several years' duration of more or less severity and those in which the cancer started suddenly from apparently good health. Of 287 cases in which such data were obtained, 71, or 24.7 per cent started from long preceding indigestion. The remaining 216, or 75 per cent, started from previous good health. An analysis of these

figures, a comparison with others would indicate that in large series of cases of cancer of the stomach, 25 per cent or more starting from long preceding or preceding indigestion. It is in this group of cases where the roentgenologist may by more careful examinations increase the percentage of accurate diagnosis, provided the patient is referred early for examination and provided the technique of his examination is sufficiently thorough. In the group of cases analyzed, namely, 75.3 per cent which started suddenly from previous good health, 69 per cent started with symptoms which, though mild, were distinctly referable to a pathologic disturbance in the upper part of the abdomen and in these cases it was also discovered that cancers which start with atypical symptoms are more apt to be in the left half of the stomach. This is a point which the roentgenologist should distinctly keep in mind, namely, that a patient with vague indefinite symptoms referable to the upper abdomen in the carcinoma age may have a lesion in the left half of the stomach and his examination should be made with that point of view in mind.

In this group of cases the average duration of symptoms was 8.1 months. In a series of cases reported by McVicar and Daly<sup>1</sup> the average duration of symptoms in the group of resectable carcinomas was 10.9 months, closely paralleling the above group of cases.

The hope, then, for improvement in the treatment of gastric carcinoma lies in the realization of the necessity of early roentgen examinations of all persons with gastric complaint.

But not too infrequently the examination is *faulty or inadequate*, as Haudek points out. He calls attention to the fact that if the results of roentgen examinations are often unsatisfactory and if, in consequence, roentgen investigation of the stomach does not yet enjoy the general confidence which

<sup>1</sup> Saltzstein, H. C., and Sandweiss, D. J. The problem of cancer of the stomach. *Arch. Surg.*, 1930, 21, 113-127.

<sup>1</sup> McVicar, C. S., and Daly, Joseph. Diagnosis of operable cancer of the stomach. *Ann. Int. Med.*, 1927-1928, 1, 152.



should be responsible for it, then the sources of error must be removed. "Familiarity with the quality of X-ray examination of the stomach is generally underestimated. In this very matter of X-ray investigation, the laity, and unfortunately a good many doctors as well, believe that an X-ray *apparatus* is the chief requisite for the production of a correct diagnosis. A man will sometimes commence independent practice, after a short apprenticeship principally devoted to learning the technique of the apparatus, who entirely lacks the rudiments of the knowledge necessary for the responsible work of a radiologist. *We must make it clear to all concerned, that the results of examination depend far more on the quality of the worker than on the quality of the apparatus.* He must, if he is a radiological specialist, have a good preliminary knowledge of pathology and internal medicine, and in the same way, an internist or surgeon who chooses to make independent X-ray examination in his consulting practice must be armed with a thorough knowledge of general radiology. He should never hesitate to call in a radiologist of special experience in cases where he feels uncertain of his own interpretation. I find that such consultations are far too rarely asked for; this is a serious misfortune for the patient.

"To attempt radiological diagnosis of stomach and duodenal conditions without being also able to make use of photographic procedure—means that the method is an incomplete one. However much the screening accomplishes, yet its completion by photography—that is by technically good radiograms, skilfully taken so as to fix or first bring to light the significant signs—is a procedure which must never be omitted. Diagnosis of commencing carcinoma, closely bound up as it is with a study of the mucosal relief pattern, is, apart from radiograms, impossible. But even experienced radiologists must needs run the risk of making mistakes if too many examinations are required of them, and if they undertake them."

In his discussion of the *method and technique* of the roentgen examination in the early diagnosis of carcinoma of the stomach, Haudek calls attention to the fact that the examination should include a case history, inspection and palpation. If the roentgenologist has had considerable experience in taking case histories and is well trained clinically this will often enable him to pick out suspicious cases of carcinoma which require special form of investigation, and not infrequently it will give him distinct leads which may enable him to make a correct diagnosis, though the patient may have been referred with a totally different diagnosis. This is particularly true in lesions of the large bowel. The roentgen examination of course always includes an examination of the chest, and the passage of the first mouthful of the barium suspension through the esophagus is followed so as to make sure that there is no lesion in this portion of the gastrointestinal tract. If a suspicious area is encountered or if the patient complains of the slightest difficulty in swallowing the barium, Haudek suggests the use of a gelatine capsule filled with one gram of barium. Many others have suggested the use of gelatine bougies cut to varying sizes and shapes, and still others have suggested the use of small bits of cracker mixed with barium so that the slow passage of these through the esophagus might be easily detected under the roentgenoscopic screen. As stated above, early lesions about the cardiac orifice are the type that are usually missed, and if the roentgenologist will be careful to vary his examination as suggested by Haudek and others, undoubtedly lesions will be observed which otherwise might escape detection.

Haudek calls attention also to his detailed examination of the stomach, which he divides into two principal parts: first, examination of the contracted stomach and its folds, and second, the examination of the more fully distended stomach. For this purpose the patient while standing



drinks at first only about 30 c.c. of a thick barium emulsion which as it trickles down is spread over the gastric wall by gentle pressure. This is a method also used to great advantage by Berg<sup>1</sup> and his co-workers. By this method "every detail from air cap to the pyloric part is carefully observed, and attention is paid to such points as a collection of secretion below the air cap, a tumour shadow projecting into the air cap, and the course, width and regularity of the mucosal folds. By turning the patient, the anterior and posterior walls of the stomach are thoroughly examined. Small ulcer niches, barium rests in tumour craters, and filling defects in any possible situation are most likely to be found at this stage. Radiograms in selected positions, usually with a small diaphragm, are taken to fix the exact appearance and allow them to be studied in detail later." This detailed examination of the stomach is too often neglected and if followed more generally would, we believe, lead to the detection of lesions of smaller size than is possible by the more generally followed method where the patient drinks immediately a large glass of barium mixture.

In the second part of the examination, after a detailed study with the small drink of thick barium mixture, the stomach is completely filled with an additional barium mixture and with the patient standing and being turned from side to side, the regularity of the contours as well as the flexibility of the walls and the gastric peristalsis are noted. If there is the slightest suspicion of carcinoma or other gastric defects, examination in the prone position is made which brings into relief the lesser curvature of the stomach more clearly. Suspicious regions are palpated for evidence of abdominal resistance while the patient is standing. Films are taken during the roentgenoscopic examination to record suspicious areas. Any number of films may be taken, but Haudek in his routine examinations recommends the tak-

ing of at least five: "That is, after the first mouthful one film in the standing, prone and supine position, after complete filling one film in standing and prone position."

It can readily be seen that if a detailed study of the gastric mucosa such as is suggested by Haudek, Berg and others, is carried out in the examination of the gastrointestinal tract, the general level of accuracy in the roentgen diagnosis of carcinoma of the stomach both in its early and late manifestations will be greatly improved. Too often the examination is carried out without a proper knowledge of the exact site of the lesions which are so frequently missed in roentgen examinations, namely, the region about the cardiac orifice and in the fundus of the stomach on its posterior wall. It may be argued that these lesions are not amenable to surgical treatment so that their early recognition by the roentgen ray is not of great importance so far as the ultimate outcome of the case is concerned. However it is well within the bounds of the possible that a surgical technique will be developed which will permit these lesions to be handled surgically and the inadequacy of the present surgical procedure should not in any way obviate the roentgenologist's responsibility in making as early a diagnosis as is possible. While the pessimism shared by many as regards the early diagnosis of carcinoma of the stomach may have a certain justification, the roentgenologist may find considerable encouragement in Haudek's conclusions:

"We may fairly hope, we may reasonably expect, that it will fall to our lot to attain in the future yet greater success in the diagnosis of the smallest tumours and of malignant changes in the mucosa over and above the results hitherto reached—results which are even now by no means to be despised. One thing is certain—that none but men equipped with a sound knowledge of pathology, clinical medicine, and radiology can ever help cancer sufferers to the earliest possible diagnosis and cure of their disease."

<sup>1</sup> Berg, H. H. Röntgenuntersuchungen am Innenrelief des Verdauungskanals. Georg Thieme, Leipzig, 1930.





WILLIAM B. BOWMAN  
1885-1930





WILLIAM B. BOWMAN  
1885-1930



## BOWMAN, M.D.

1885-1930

THE many friends of Dr. Bowman will be grieved to learn of his sudden death which occurred in Los Angeles on October 20, 1930. He arrived home from his eastern trip where he attended the meeting of the American Roentgen Ray Society at West Baden, on Sunday morning, October 19. That afternoon he went to his office where he took care of his accumulated correspondence and other matters. About six o'clock he complained of feeling tired and went home. The following morning no one heard from him and an investigation found him dead in bed. The cause of his death was myocarditis and coronary thrombosis.

Dr. Bowman was born on November 6, 1885, and graduated from St. Louis University School of Medicine in 1910. Shortly afterward he went to Los Angeles where he served as interne at St. Vincent's Hospital. About 1912 he became interested in roentgenology and very shortly afterwards devoted his entire time to it. He made many contributions to the study of roentgenology; probably his most well-known contributions were his interesting studies on coccidioidal granuloma. He served with distinction during the World War, being retired with the rank of Major. He was a member of many social clubs and organizations in Los Angeles and had innumerable friends both in and out of the profession. Bill, as he was familiarly known by those who knew him, was a rugged character, with, however, a very soft kindly side, and

at the annual meetings of the American Roentgen Ray Society he was always the center of an admiring group of friends where his cheerfulness and keen repartee will be sadly missed at subsequent meetings. He was never averse to entering a controversy, provided it was a clean one, never holding any grudges against an honest opponent. He was at times difficult to influence but once he gave his hearty support to a proposition he was "there for good." He could always be depended upon to support anything pertaining to the furtherance of the ideals of his profession. An exemplification of this was never better given than when he led the State Society fight in California some years ago at a time when it looked as though the practice of roentgenology would be officially turned over to technicians. Many of us participated in this controversy which undoubtedly would have been lost if it had not been for Bill's dogged persistence in holding out for no compromise, as a result of which there was a complete backing down of the opposition. All of us will be forever indebted to him for his part in this controversy.

His place in the community will be hard to fill and his place in the hearts of those who knew him well will never be filled, and in his death roentgenology has lost a keen observer and a splendid counselor.

R. G. TAYLOR

## WILLIAM B. BOWMAN

### AN APPRECIATION

THE chronology of the events of Bill Bowman's short life can be recorded but the cheerfulness and the charms of this bright-errant of Western Coast Roentgenology is the theme of my eulogy.

Not long ago he related why he deter-

mined to go into medicine and eventually roentgenology. It seems that he was working or rather slaving in a railroad office and felt that the future was going to be rather a routine piece of drudgery; so he decided to look into the professions. He decided that



His stature was not a handicap. He proceeded to make inquiries. His first interview was with a physician who dilated upon the difficulties and the demand for brain work in attaining the education necessary and he rather doubted Bill's ability to complete the medical course. Such admonitions were enough to raise the combativeness or ambitions of Bill and he proceeded at once to matriculate in medicine. He completed this job well and in the process was impressed and interested by his instructor in roentgenology at St. Louis University, Russell D. Carman. He decided to become a roentgenologist and go West.

He settled in Los Angeles and proceeded to make his place in the city and in his state and along the coast before he ventured to the American Roentgen Ray Society meeting at Boston in 1913. Since that time he has been an intimate part of the science and fellowship of American Roentgenology. This friendliness and comradeship was such a big part of his small body that everyone was always surprised when the science of the man displayed itself.

Bill played hard and worked hard. He penalized himself for every indulgence. He constantly set for himself goals far ahead and he reached these goals only to place the markers farther ahead. Whatever the deflections of life, pleasure and friends, Bill stuck to his task at the expense of his small

was not. He was ready to acknowledge that Bill had about completed the job of life before his heart took the disastrous rôle of the Achilles tendon of that ancient hero of Greece.

Any eulogy of Bill Bowman must narrate his abilities as a scientist; his patriotic devotion as a soldier, and a consummate friendliness with all manner of men.

As a scientific physician he displayed originality and astute observation of clinical and roentgen phenomena. Witness his original work upon coccidioidal granuloma as displayed in bone and his observations upon spondylolisthetic spines.

As a soldier he took a most active part in the World War as Commandant of the Los Angeles School of Military Roentgenology, and later conducted the x-ray school of the A. E. F. at advanced medical headquarters. All of these activities were sacrifices to his patriotism.

The friendliness, the cheerfulness, the kindness of this knight-errant will be fine memories to his host of acquaintances throughout the world. He possessed a fine spirit, a glorious tolerance and a smiling mind.

Thus passeth a gallant knight-errant! Salute!

E. H. SKINNER

## RICHARD MARK BROWN, M.D.

1884-1930

**D**R. RICHARD MARK BROWN of Ogden, Utah, died September 12, 1930 in Holy Cross Hospital, Salt Lake City, Utah, following an operation on September 8.

Dr. Brown was born in Ogden, Utah, on April 17, 1884, the son of Mr. and Mrs. Richard T. Brown. He was the grandson of Dr. Jesse James Murphy, a pioneer Utah physician, who came to Utah in 1869 from

Georgia. Dr. Brown originally planned to follow the engineering profession, having studied engineering at the Utah State Agricultural College, Logan, Utah, for three years, prior to beginning the study of medicine. Dr. Brown took his medical training at the University of Utah and Columbia University, graduating from the latter in 1912. He interned in the New York Post Graduate Hospital, later return-



ing to medical work. While in the United States Army for service in the World War, he became interested in roentgenology, and after discharge went to the New York Post Graduate Medical School for special training in this field. On completion of the course he opened an office in Ogden, limiting his practice to roentgenology. He later also opened an office in Salt Lake City, Utah. For several years he was roentgenologist to the Dee Memorial Hospital at Ogden.

Dr. Brown was married in 1917 to Miss Mary Wattis, who survives him. He is also survived by his mother, a sister, and four children.

Dr. Brown was a member of the Uintah County Medical Society, Utah State Medical Association, American Roentgen Society and the Radiological Society of North America. He was for several years counselor for the state of Utah in the last named Society.

JAMES P. KERBY

---

As we go to press, we learn with great regret of the death of Dr. Preston M. Hickey, Professor of Roentgenology, University of Michigan, Ann Arbor, Michigan. An account of Dr. Hickey's life and work will appear in an early issue of the Journal.

---



# SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

*Items for this section solicited promptly after the events to which they refer.*

## MEETINGS OF ROENTGEN SOCIETIES\*

### UNITED STATES OF AMERICA

#### AMERICAN ROENTGEN RAY SOCIETY

Secretary, Dr. John T. Murphy, 421 Michigan St., Toledo, Ohio.

Thirty-second Annual Meeting: Atlantic City, N. J., 1931.

#### AMERICAN COLLEGE OF RADIOLOGY

Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles, Calif.

Annual Meeting: Philadelphia, 1931.

#### SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION

Secretary, Dr. G. W. Grier, Jenkins Arcade, Pittsburgh, Pa.

Annual meeting: Philadelphia, 1931.

#### RADIOLOGICAL SOCIETY OF NORTH AMERICA

Secretary, Dr. I. S. Trostler, 812 Marshall Field Annex, Chicago, Ill.

Sixteenth annual session: Los Angeles, Calif., Dec. 1-5, 1930.

#### RADIOLOGICAL SECTION, LOS ANGELES COUNTY MEDICAL SOCIETY

Secretary, Dr. Orville N. Meland, 1407 S. Hope St., Los Angeles.

Meets on the third Wednesday of each month at the California Hospital.

#### RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION

Secretary, Dr. W. S. Lawrence, Medical Arts Bldg., Memphis, Tenn.

#### BUFFALO RADIOLOGICAL SOCIETY

Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St.

Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.

#### CHICAGO ROENTGEN SOCIETY

Secretary, Dr. George M. Landau, 660 Groveland Park.

Meeting second Thursday of each month October to May inclusive at Virginia Hotel.

#### CLEVELAND RADIOLOGICAL SOCIETY

Secretary, Dr. A. Strauss, 518 Medical Arts Bldg.

Meetings are held at 6:15 P.M., at the Cleveland Chamber of Commerce Club rooms on the fourth Monday of each month from October to April, inclusive.

#### DETROIT ROENTGEN RAY AND RADIUM SOCIETY

Secretary, Dr. O. J. Shore, Fisher Building.

Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

#### CENTRAL ILLINOIS RADIOLOGICAL SOCIETY

Secretary, Dr. H. C. Kariher, Decatur, Illinois. Regular meetings held quarterly.

#### INDIANA ROENTGEN SOCIETY

Secretary, Dr. J. N. Collins, Indianapolis, Ind. Annual meeting each February 22 in Indianapolis.

#### MILWAUKEE ROENTGEN RAY SOCIETY

Secretary, Dr. J. E. Habbe, 221 Wisconsin Ave., Milwaukee.

Meets first Friday in October, December, February and April.

Place of meeting designated by the president.

#### MINNESOTA RADIOLOGICAL SOCIETY

Secretary, Dr. L. G. Rigler, University Hospital, Minneapolis, Minn.

Next meeting, to be announced.

#### NEW ENGLAND ROENTGEN RAY SOCIETY

Secretary, Dr. Thomas R. Healy, 370 Marlboro St., Boston, Mass.

Meets monthly on third Friday, Boston Medical Library.

#### NEW YORK ROENTGEN SOCIETY

Secretary, Dr. J. Bennett Edwards, Englewood Hospital, Englewood, N. J.

Meets monthly on third Monday, New York Academy of Medicine, at 8:30 P.M.

#### CENTRAL NEW YORK ROENTGEN RAY SOCIETY

Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

#### PACIFIC COAST ROENTGEN RAY SOCIETY

Secretary, Dr. Harold B. Thompson, Seattle, Wash. Two meetings a year.

#### PENNSYLVANIA RADIOLOGICAL SOCIETY

Secretary, Dr. W. E. Reiley, Clearfield, Penna.

Two meetings a year, April and October.

#### PHILADELPHIA ROENTGEN RAY SOCIETY

Secretary, Dr. Karl Kornblum, 3400 Spruce St. Meeting first Thursday of each month from October to May inclusive, at 8:15 P.M., in Thomson Hall, College of Physicians, 19 S. 22d St.

\* Secretaries of societies not here listed are requested to send the necessary information to the Editor.



# ROCHESTER ROENTGEN RAY SOCIETY,

ROCHESTER, N.Y.

Secretary, Camp C. Thomas, 476 Lake Ave.

Meets monthly on the first Friday evening at 7:45 at the Rochester Medical Association Building.

## ST. LOUIS ROENTGEN CLUB

Secretary-Treasurer, Dr. L. R. Sante, Missouri Building.

Meets first week of each month. Time and place of meetings designated by president.

## TEXAS RADIOLOGICAL SOCIETY

Secretary-Treasurer, Dr. C. P. Harris, Houston, Texas.

Meets annually one day preceding the meeting of the Texas State Medical Association.

## UNIVERSITY OF MICHIGAN ROENTGEN RAY SOCIETY

Secretary, Dr. D. M. Clark, University Hospital, Ann Arbor, Mich.

Meets every Wednesday evening from September to July, at 7:30 o'clock in the amphitheatre of the University Hospital.

## VIRGINIA ROENTGEN RAY CLUB

Secretary, Dr. Wright Clarkson, 205 S. Sycamore St., Petersburg, Va.

Next meeting, to be announced.

### CUBA

## SOCIEDAD CUBANA DE RADIOLOGIA Y FISIOTERAPIA

Secretary, Dr. Francisco Padron, Enrique Villuendas 64, Havana, Cuba. Meets monthly in Havana.

### BRITISH EMPIRE

## BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY

Meets on the third Thursday of each month, from November to June inclusive, at 8:15 P.M., at 32 Welbeck St., London, W. 1., or as advertised.

## ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)

Meets on the third Friday of each month during the winter at 8:30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

## SECTION OF RADIOLOGY AND MEDICAL ELECTRICITY, AUSTRALASIAN MEDICAL CONGRESS

Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

## RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION

Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.

Meets monthly at Melbourne during the winter.

## SECTION ON RADIOLOGY, CANADIAN MEDICAL ASSOCIATION

Secretary, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.

## RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION

Secretary, Dr. P. C. Fenwick, The Hospital, Christ-church.

Meets annually.

### CONTINENTAL EUROPE

## BELGIAN SOCIETY OF ROENTGENOLOGY

Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).

Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

## SOCIÉTÉ DE RADIOLOGIE MÉDICALE DE FRANCE

Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

## SOCIÉTÉ SUISSE DE RADIOLOGIE (SCHWELZERISCHE RÖNTGEN-GESELLSCHAFT)

Secretary for French language, Dr. A. Grosjean, La Chaux de Fonds.

Secretary for German language, Dr. Scheurer, Molzgasse, Biel.

Meets annually in different cities.

## SOCIÉTÉ FRANCAISE D'ELECTROTHÉRAPIE ET DE RADIOLOGIE MÉDICALE

Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

## ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHOSLOVAKIA

Secretary, Dr. Walter Altschul, German University, Prague, 11/52.

## DEUTSCHE RÖNTGEN-GESELLSCHAFT (GESELLSCHAFT FÜR RÖNTGENKUNDE UND STRAHLENFORSCHUNG)

Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.

Permanent secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.

## SÜD- UND WESTDEUTSCHE RÖNTGENGESELLSCHAFT

Meets annually in different cities.

## NORD- UND OSTDEUTSCHE RÖNTGENGESELLSCHAFT

Meets annually in different cities.

## DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY

Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.



## SOCIETA' ITALIANA RADIOLOGIA

Secretary, Professor M. Ponzio, University of Turin, Turin.

## SOCIETATEA ROMANA DE RADIOLOGIE SI ELECTROLOGIE

Secretary, Dr. Nicolae Busila, 44 Elizabeta Blvd., Bucarest.

Meets second Monday in every month with the exception of July and August.

## ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.

Secretaries, Drs. S. A. Reinberg and S. G. Simonson.

Meets annually.

## LENINGRAD ROENTGEN RAY SOCIETY

Secretaries, Drs. S. G. Simonson and G. A. Gusterin.

Meets monthly on the first Monday at 8 o'clock in the State Institute of Roentgenology and Radiology, Leningrad.

## MOSCOW ROENTGEN RAY SOCIETY

Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.

Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

## POLISH SOCIETY OF RADIOLOGY

Secretary, Dr. A. Elektorowicz, 19 Hoza St., Warsaw. Meets annually.

## WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY

Secretary, Dr. B. Krynski, 11 Zielna St.

Meets once a month except in the summertime.

## SCANDINAVIAN ROENTGEN SOCIETIES

The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with the exception of the Denmark Society, meets every second month except in the summertime:

## SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN

Meets in Stockholm.

## SOCIETY OF MEDICAL RADIOLOGY IN NORWAY

Meets in Oslo.

## SOCIETY OF MEDICAL RADIOLOGY IN DENMARK

Secretary, Dr. O. Wissing, Copenhagen.

Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

## SOCIETY OF MEDICAL RADIOLOGY IN FINLAND

Meets in Helsingfors.

## VIENNA SOCIETY OF ROENTGENOLOGY

Secretary, Professor Holzknacht, Vienna, IX, General Hospital.

Meets on the first Tuesday of each month from October to July.

Dr. L. Gidro exhibited a patient to the medical society who, while being screened, touched a live wire conducting a current of 15,000 volts. Instantly following the accident the patient became unconscious and remained so for twenty-four hours. Directly under the mastoid process, where the current entered, was seen a zigzag line, one-fifth of an inch wide, extending down to the level of the manubrium. The epidermis was destroyed over the whole length of this area, which was covered by a parchment-like dried skin. On the outer surface of the right upper and lower limbs several sharply outlined necrotic patches about the size of a shilling were observed and similar patches were also seen on the tips of the toes and on the heel at the site of the exit of the current. The latter were typical electric current marks. These areas healed in three weeks leaving soft scars. Dr. Gidro pointed out the fact that this case shows that the injury and eventual death caused by electric currents depends not so much on the tension as on the intensity of the current passing through the body. Of course great individual fluctuations may be experienced. In general, however, we may assume that a current of one ampere can kill a man. Of all the organs of the human body, the greatest resistance against the current is offered by the skin, in comparison with which the resistance of the other tissues is quite negligible. Death in most of these cases is preceded by a trance and artificial respiration should be applied for hours even, because in individual instances the patient can be resuscitated in this way. It is very important that this fact should be taught to the laity as well as to medical men. Dr. Zemleni added that in cases of algid asphyxia of the new-born artificial respiration should be carried on as long as heart action continues. The lethal effect of the electric current depends not



that the present way of storing radium may act quite harmfully on workers in close proximity to the safe containing the radium, even if the radium is in relatively small quantities. In his opinion, radium ought not to be stored in a place where people are working even for a few hours. Even a safe having a wall of lead block of 7 cm. thickness does not lend sufficient protection against the radium rays for individuals regularly working in close proximity to it. He suggests the building of a special room for the location of radium safes and though the room ought to be the size of a regular living room it ought not to be used for anything except the storage of radium.

#### ROENTGENOLOGICAL CONFERENCE

##### BALTIMORE, MARYLAND

The roentgenologists of Baltimore have invited the Roentgenological Conference (composed of the New England Roentgen Ray Society, New York Roentgen Society, Philadelphia Roentgen Ray Society, the radiologists of Washington, D.C., and the radiologists of Baltimore) to meet in Baltimore on February 6 and 7, 1931. The Lord Baltimore Hotel will be the headquarters of the meeting. Bus transportation will be furnished to and from the various meeting places.

It is contemplated having the opening

session at the Johns Hopkins Hospital, Friday morning at 9 o'clock. The afternoon session at the University of Maryland Hospital. Entertainment will be provided for Friday night. Saturday the scientific session will be held at the Mercy Hospital. The Staff of the Howard A. Kelly Hospital will conduct a clinic on roentgen and radium therapy.

Those in charge of arrangements for the conference are: Dr. Charles A. Waters, Chairman, 1100 North Charles St., Baltimore, Md., Dr. Henry J. Walton, Secretary, 104 West Madison St., and Dr. John W. Pierson, Treasurer, 1107 St. Paul St. Additional information may be obtained by anyone interested in attending this conference by writing the Chairman.

#### OFFICERS ELECTED

At the recent annual meeting of the American Roentgen Ray Society at West Baden, Indiana, the following officers were elected for the ensuing year: President-elect: Leopold Jaches, New York City; 1st Vice-President: E. L. Jenkinson, Chicago; 2d Vice-President: E. P. Pendergrass, Philadelphia; Secretary: John T. Murphy (re-elected), Toledo, Ohio; Treasurer: Wm. A. Evans (re-elected), Detroit, Mich.; Librarian and Historian: E. H. Skinner, Kansas City, Mo.; Member of the Executive Council: Charles A. Waters, Baltimore, Md. The President of the Society is A. B. Moore, Washington, D. C.





# IMPROVEMENT OF THE ROENTGEN DEMONSTRATION OF THE GALL-BLADDER

Dr. Schemensky of Küstrin, Germany, states that by the administration of a very strong cholagogue (any efficacious cholagogue will do; he made his experiments with a very reliable, strong cholagogue called decholin) in conjunction with the gall-bladder dye he succeeded in securing a quicker pouring out of the dye stored in the liver, thereby hastening the visualization of the gall-bladder shadow. He gives the dye orally or intravenously, while the cholagogue itself he always gives intravenously. In the first experimental series, the gall-bladder dye was injected in the morning and one to two hours subsequently, when the dye had reached the liver, 10 c.c. of a 20 per cent cholagogue solution was given. Within three to four hours subsequent to the injection of the dye distinct shadows of the gall-bladder could be seen on the roentgenogram. This method marks distinct progress in the cholecystographic examination because it shortens the time of the examination, renders the exposure of several films superfluous and shortens the period during which the patients must go without food. He also mentioned the fact that the occasionally observed disagreeable after-effects of the intravenous administration of the dye were avoided through the injection of cholagogues. In the second series of experiments, the gall-bladder dye was given to the patients in the morning, according to the Sandström method, at varying intervals by mouth, and a short time afterwards the cholagogue was given intravenously. In spite of numerous experiments and innumerable roentgenograms it was impossible to ascertain any acceleration of the appearance of the gall-bladder shadow. Similar results were also

Rosenthal who likewise found that the administration of a cholagogue considerably shortens the period before the appearance of the gall-bladder shadow, but only in case the dye is given intravenously, while there is no difference if the dye is given by mouth.

## ROENTGEN APPARATUS WHICH GIVES ABSOLUTE SAFETY AGAINST HIGH TENSION CURRENTS IN ROENTGEN INSTALLATIONS

In the Spring of this year, the German Ministry of Public Welfare enacted a law which prescribes the rules to be observed by all roentgen laboratories and electrotherapeutic institutes working with high tension currents. The observation of these rules will obviate electrical accidents. In characteristic fashion, German roentgen manufacturers immediately upon the enactment of this law, hastened to build sets conforming to these rules and regulations, although this meant a great sacrifice on their part because they had to transform all their sets in stock to conform to this regulation. Some of the manufacturers brought out rather ingenious devices of protection; for instance, one constructed a portable roentgen apparatus which is capable of supplying a current of 10 ma. and 63,000 volts, the whole apparatus from the switches to the tube forming a unit which may be touched anywhere without coming in contact with live wires. Another firm built a large deep therapy apparatus whose transformer, tubes and stand constitute one fully protected unit, lending absolute safety against high tension currents. In fact the apparatus was so constructed that it might be touched anywhere with impunity. The law includes a paragraph which gives instructions about what to do with old apparatus which is at present in use in order to bring it up to date as regards protective measures.

## EXPERIMENTAL CONTRIBUTION TO THE PROPER STORAGE OF RADIUM

Professor Mühlhardt, Berlin, gave as his opinion from his extensive experience,



## BOOK REVIEWS

*Books Received Are Acknowledged under Heading: Books Received. This may be regarded as a courtesy of the sender. Selections will be made for review in the interests of our readers.*

ERGEBNISSE DER MEDIZINISCHEN STRAHLENFORSCHUNG (RÖNTGENDIAGNOSTIK, RÖNTGEN-, RADIUM- UND LICHTTHERAPIE). (Advances in Medical Radiology (Roentgen Diagnosis, Roentgen, Radium and Light Therapy).) Volume IV. Edited by H. Holtfelder, Frankfurt a. M., H. Holthausen, Hamburg, O. Jüngling, Stuttgart, H. Martius, Göttingen, and H. R. Schinz, Zurich. Paper, price 71 Marks; bound, price 74 Marks. Pp. 694, with 395 illustrations. Leipzig: Georg Thieme, 1930.

The high standard of this work has been kept up in the fourth volume which is now available to the physician interested in radiology.

In the first article, M. Lüdin (Basel) discusses the changes in form and position of the stomach due entirely to extragastric causes. The stomach itself is not diseased in such cases but some pathology in the neighboring organs, for instance, a cyst of the pancreas, ileus of the small intestine, or liver tumors are responsible for the deviation from the normal as observed in the roentgenogram. The same pathological process in the neighboring organs may cause entirely different deformities of the stomach outline; their interpretation is often difficult. The contribution of Lüdin gains in value because the majority of the cases reviewed here are controlled either by operation or autopsy.

Very instructive from the standpoint of differential diagnosis is the essay by K. Scheele (Essen), who points out how much help may be rendered by a pyelogram in the diagnosis of abdominal tumors. The files of V. Schmieden's clinic furnished part of the cases discussed by the author.

The next three articles deal with problems in light therapy. A. Adam (Leipzig) reviews the investigations in ultraviolet light and vitamin D and their rôle in the treatment of rickets. Ph. Keller (Freiberg), who is an acknowledged authority on light research, discusses the relations between pigmentation and light protection. The very extensive contribution of Adam (131 pages) gives an excellent idea of the present status of our knowledge concerning irradiated substances. In the third paper of this group, L. Schall (Homburg) has

written a concise and critical presentation of the fundamental principles accumulated through experimental and clinical investigations of "The Light Erythema." The beginner will profit from its study and the worker in the field should enjoy reading Schall's essay.

Then follow "The Histology of the Uterine Carcinoma in its Relation to Radiation Therapy" by H. R. Schmidt (Düsseldorf), "The Principles of the Biological Healing of Carcinoma" by W. Lahm (Chemnitz), and "The Operated Stomach" by H. Meyer and W. S. Schmidt (Göttingen). They are all well written and offer the reader interested in the various subjects valuable information. The book closes with a discussion of "Diathermy in Diseases of the Throat, Nose, and Ear" by E. Lüdecke (Bielefeld).

As in previous volumes, all contributions are well illustrated. The bibliographies appended to each article cover the international literature. This fourth volume deserves a place on the shelves of the roentgenologist's library.

ERNST A. POHLE

NORMALE ANATOMIE DES KOPFES IM RÖNTGENBILD. I. Teil. (Radiologische Praktika, Band XII.) Von Karl Goldhamer, Leiter des Röntgenlaboratoriums an der I. Anatomischen Lehrkanzel (Prof. Tandler) in Wien. Cloth. Price, M. 120. With 30 photographic plates, 30 illustrative schemas and 15 projection diagrams. Leipzig: Georg Thieme, 1930.

The anatomy of the skull as depicted by the roentgenogram has been the subject of previous works of much merit. We have seen none which combines the excellent features of this volume, in support of which statement we submit the following:

1. Fifteen projections are presented, giving all positions for practical work.
2. Each projection is in duplicate, using both the dried skull with its great detail, and the living skull which reproduces actual working conditions.
3. Each of the thirty plates is carefully indexed, not in such manner as to mar the print but by sketching on transparent material all



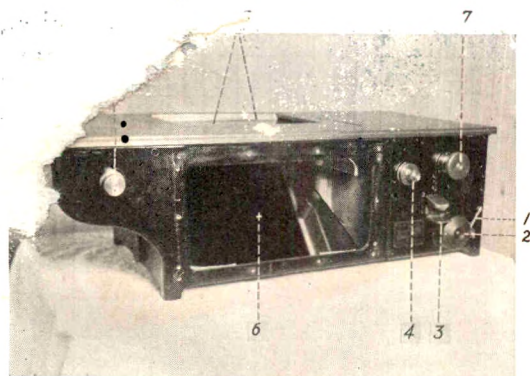


FIG. 6. Outer appearance of camera, cloth hood for roentgenoscopic observation of each exposure removed. 1. Motor switch. 2. Contact for roentgenoscopy. 3. Contact for exposure covered by protecting roof. 4. Shaft of gear, selecting desired length of exposed film sections (see Fig. 4—No. 5). 5. Diaphragm. 6. Mirror for visual observation of roentgenoscopic image (see Fig. 1—Nos. 10 and 11). 7. Rods mounting film spools.

standard roentgen equipment would perform the following cycle: Advancing of a film band to a determined position; clamping of a certain section of this band between intensifying screens; automatic exposure of this section by an electrically operated timer; releasing of the clamping intensifying screens from the film band and again advancing this band for one section, etc., speed 3 to 4 exposures per second. Two models of such an apparatus, which we have called the cin-ex camera, are completed and in operation at the Grace Hospital, Detroit. The accompanying illustrations show the two solutions of the technical problem.\*†

\* Dr. W. A. Babcock, Director of Grace Hospital, and the Board of Trustees have shown great interest in our work, and without their material help our results could not have been obtained. As stated above, the construction of a roentgen cinematograph was not contemplated. The present equipment, the

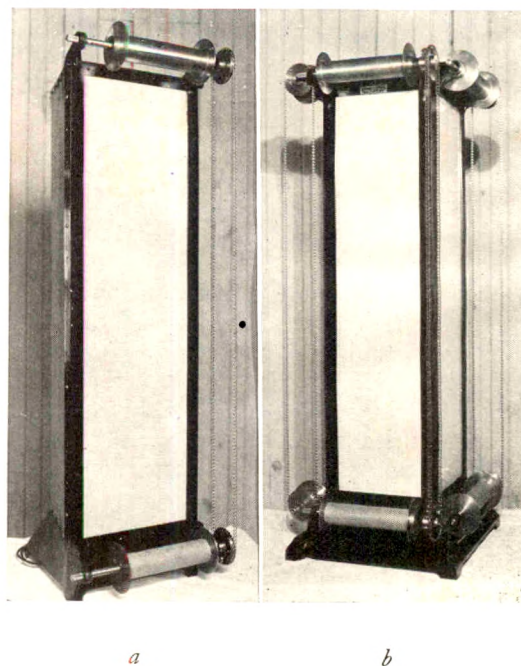


FIG. 7. Viewing stands for finished film bands. *a*. Single. *b*. Four illuminated surfaces. While we study and analyze our finished film bands on viewing stands as illustrated above, it is desirable to obtain reductions of such records on slide films and project them with an ordinary slide film camera for demonstration to an audience. Animated films may also be obtained from cin-ex camera films by proper reproduction as moving picture films.

hand operated as well as the motor driven model, answers our practical and research needs to complete satisfaction. It should be noted that the cin-ex camera can well be used for routine roentgenography of larger series of patients. Instead of shifting numerous cassettes, one may place patient after patient on the apparatus, make any number of exposures and develop one roll of film band instead of 20 to 80 cut films, care being taken to identify exposures correctly. Thus a great saving in time and handling may be accomplished.

† The two cameras were built by Mr. Albert Stöckert, Central Tool and Engineering Company, Detroit. Mr. Stöckert ingeniously produced all necessary designs, castings, etc., patiently overcoming the obstacles and adding improvements to the original conception. To him, therefore, I owe a great debt of gratitude.

#### REFERENCES

1. JARRE, H. A. The cin-ex camera. *Grace Hosp. Bull.*, 1929, 13, 3-14.
2. HUDSON, W. A., and JARRE, H. E. Cin-ex camera studies of the tracheo-bronchial tree. *Grace Hosp. Bull.*, 1929, 13, 15-34.
3. HUDSON, W. A., and JARRE, H. A. Functional studies of the tracheo-bronchial tree. *Brit. J. Radiol.*, 1929, 2, 523-533.
4. HASLEY, C. K., and DETOMASI, R. Q. Cin-ex camera studies of the thymus in infants and children. *J. Michigan M. Soc.*, 1930, 29, 25-28.
5. JARRE, H. A. Roentgenologic studies on physiologic motor phenomena (with the aid of the cinex-camera). *Radiology*, 1930, 15, 377-394.
6. JARRE, H. A., and CUMMING, R. E. Cin-ex camera studies on the urinary tract, a method of functional investigation; preliminary report. *J. Urol.*, October, 1930.



Equipment for functional roentgenologic studies must be able to secure records at a speed sufficient to permit of the analysis of individual cyclic motor phenomena, wherever they occur. Only one of the motor phenomena occurring in the human body requires true cinematographic study,

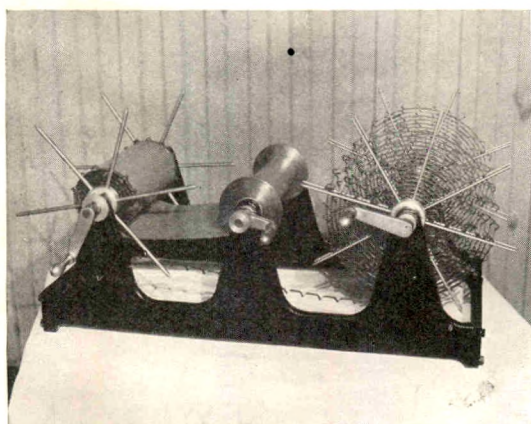


FIG. 3. Model 1. Equipment for processing film bands. The spider to the left when charged with exposed band and corrugated metal spacing bands is submerged in chemicals, the processing being governed by time exclusively.

preferably of slow-motion type—the function of the heart. It is questionable whether or not, in this instance, appreciable practical advantages could be obtained by the employment of such a method of study. It seems to us that all other motor phenomena, which may be registered roentgenologically, are so slow that serial exposures, executed at a slower rate of speed, ranging from one to three exposures per second, should be sufficient to permit of their proper evaluation. Equipment answering this purpose obviates the limitations of roentgen cinematography, compensates for the disadvantages of roentgenoscopy and therefore seems ideal for practical purposes, especially as it entirely eliminates the necessity for any other special installation, adapting itself to the average roentgenologic provisions. With such an apparatus we would expect to materially improve the roentgenographic method which then could be applied to physiologic investigation.

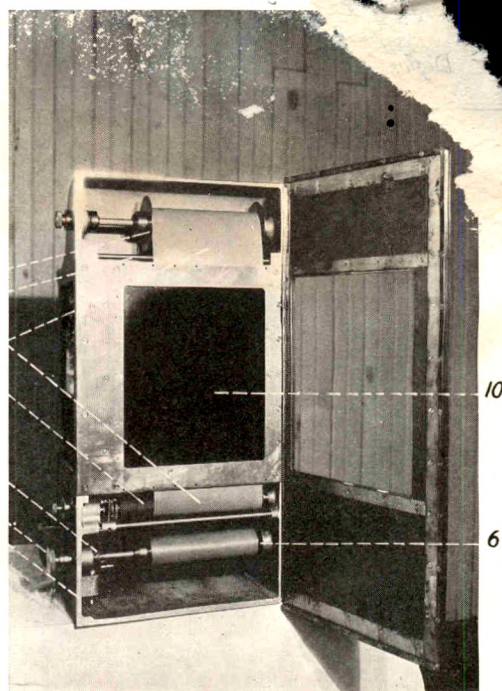


FIG. 4. Model 2. Motor driven camera, opened, may be utilized in any position, accommodating film bands of four different widths as in Model 1. Diaphragm removed. Motor not visible. Numbers identical with Figure 1 except: 5. Governing roll; gears to the left select desired length of exposed sections (see above).

Since the Fall of 1928 we have had under way design and construction of such an apparatus, which in combination with

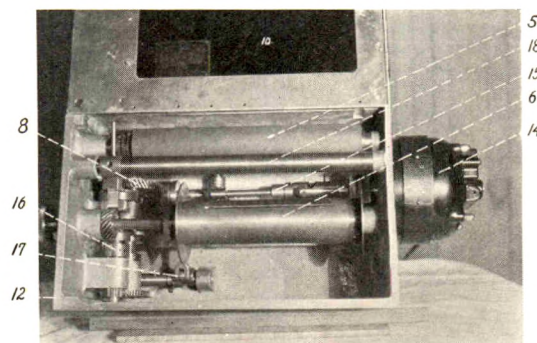


FIG. 5. Model 2. Mechanism of motor driven model. 14. Motor. 15. Driving shaft. 16. Brown-Sharp clutch. 8. Timing gear; its continuous revolution actuates three exposures per second. 18. Rubber mounted roll pressing film band against governing roll, 5.



## THE CIN-EX CAMERA

By HANS A. JARRE, M.D.

From the Department of Roentgenology, Grace Hospital  
 DETROIT, MICHIGAN

MEDICAL thought is paying increased attention to functional investigations. This tendency is quite apparent in the field of roentgenology, where for well-known reasons, anatomic studies have dominated from the beginning and will always play an important rôle. Roentgenoscopy has been the chief roentgenologic method of investigation of function. Its

limitations in recognizing pathology are well known—faintness of a fleeting image, observation by one or a few only, lack of visual perception of the observer, and the impossibility of reproduction of the observations for reconsideration. Condemnation of the roentgenoscopic method and the demand of its replacement by serial roentgenography as advocated by leaders in

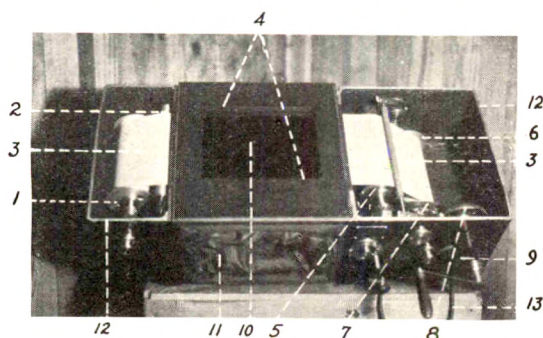


FIG. 1. Model 1. Camera with cover of right and left compartments removed. 1. Film spool, widths of 5, 6½, 8 and 10 inches may be employed at will. 2. Leveling roll. 3. Film band, widths of 5, 6½, 8 and 10 inches may be employed at will. Film bands are not perforated. 4. Diaphragm (lead) determining size of exposed section of film band. 5. Governing roll, advancing film band, exchangeable for different lengths of exposed sections: 7, 8½, 10, or 12 inches. 6. Spool receiving exposed film band. 7. Friction gear. 8. Timing gear; one-half of its circumference advancing film band, one-half activating clamping and releasing mechanism of intensifying screens (9) and energizing electrical timer. 10. Bakelite plate—upper. Its lower surface carries an intensifying screen. The second such plate cannot be seen as it is mounted below the visible one, carrying the intensifying screen on its upper surface; a fluoroscopic screen on its lower surface, to be viewed through a mirror underneath cloth hood (11). 12. Cast aluminum casing, lead lined. 13. Connection to electrical timef.

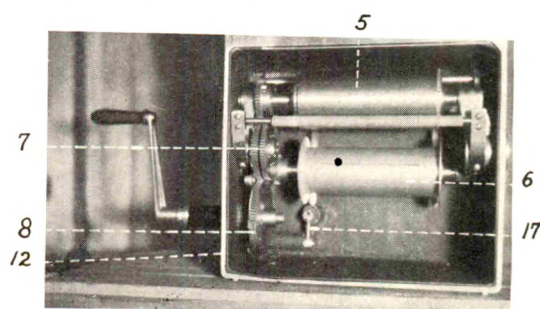


FIG. 2. Model 1. Mechanism of camera. Numbers identical with those in Figure 1. 17. Lever activating motion of lower intensifying screen from timing gear.

roentgenology would not be regarded as a revolutionary step. We believe that both methods have their place and indication, and should be used with discrimination.

Suitable equipment for serial roentgenography has not been available in years past. Roentgen cinematographs heretofore constructed (Dessauer, Groedel, Ruggles) are not suitable for practical purposes, their inherent technical and economic limitations being quite evident. Available equipment for so-called serial exposures has not succeeded in producing a satisfactory record of motor phenomena of organs under investigation.



the marking of the plates, and in sat-  
 ing them on the page.

4. The text is given in four parallel  
 columns in English, French and Span-  
 ish, making the book of universal scope, as  
 well as enabling the roentgenologist to review  
 and enlarge his knowledge of scientific terms  
 in foreign languages.

5. All plates are photographic negatives, of  
 natural size and excellent detail.

A minor criticism might be made of the use  
 of a plate which shows a pathological condition,  
 namely a clouded antrum. This slight fault  
 does not, in our opinion, detract from the  
 value of this estimable work which must be  
 seen to be truly appreciated.

E. W. HALL

THE BEGINNINGS: EGYPT AND ASSYRIA. (Clio  
 Medica, Volume I.) By Warren R. Dawson,  
 F. R. S. E., Fellow of the Royal Society of  
 Medicine, of the Society of Antiquaries of  
 Scotland, and of the Royal Anthropological  
 Institute of Great Britain and Ireland. Cloth.  
 Price, \$1.50. Pp. 86. New York: Paul B.  
 Hoeber, Inc., 1930.

This book is the initial volume of a series  
 called "Clio Medica" which is to be written  
 by a series of authors with Dr. E. B. Krumhaar  
 as editor. The volumes are to be conveniently  
 small and inexpensive but written by recog-  
 nized authorities in the various fields. The

first volume has been written in a readable and  
 pleasant style by an author who has made a  
 careful study in this particular field and based  
 his conclusions on original observations from  
 reliable sources such as the Egyptian medical  
 papyri. The contents of the book are conven-  
 iently grouped into eight chapters as follows:

- I. Primitive Ideas of Disease and Death.
- II. Averting Death and Prolonging Life.
- III. The Magician.
- IV. The First Medical Books.
- V. Ancient Egyptian Medicine.
- VI. The 'Pothecary.
- VII. Assyrian Medicine.
- VIII. The Legacy of the Past: Conclusion.

The editor is to be congratulated on intro-  
 ducing such an admirable plan of dealing with  
 the various phases of the history of medicine.  
 The medical profession at large, as well as un-  
 dergraduate medical students, would profit  
 greatly from an intellectual, as well as a prac-  
 tical standpoint, if they have a knowledge of  
 the historic development of the art and sciences  
 of medicine. It is hoped that the subsequent  
 volumes will maintain the high standard of  
 the first contribution to "Clio Medica."

The author has very thoughtfully included  
 a bibliographical note for those who wish to  
 investigate further the subjects outlined in  
 this book.

C. C. STURGIS



# INDEX TO

## ROENTGEN DIAGNOSIS

### Head

- LASZLO, EDITH: Contribution to the roentgen diagnosis of space-narrowing processes in the cranium..... 582
- PESME, PAUL: Roentgen study of a case of Crouzon's disease..... 582

### Neck and Chest

- PODLASKY, H. B., and KOHN, S. E.: Thymic shadows of new born infants..... 582
- CHAUMET, G.: Pleuritis and apical cortico-pleuritis..... 583
- ARKUSKY, I.: The roentgen image of congenital stenosis of the pulmonary artery with simultaneous defect of the ventricular septum..... 583
- GALIFI, LIBORIO: The capillary line in the right lung field..... 583
- BUSI, A., and PAOLUCCI, R.: Percentage of latent tuberculosis and primary complexes demonstrable roentgenologically in the children of a rural district..... 584
- ST. DEDIĆ: Differential diagnosis of cor bovinum..... 584
- VISCHIA, QUINTINO: Roentgen and clinical study of the relation between mitral lesions and pulmonary tuberculosis..... 585
- BÁRSONY, THEODOR, and KOPPENSTEIN, ERNST: Lobus apicodorsalis, a hitherto unknown localization of the azygos lobe.. 585
- AIRALE: Secondary echinococcus of the lung and its site..... 585
- DELHERM, and MOREL-KAHN: Diagnosis of tumors of the lung in the adult..... 585
- BAUERMEISTER, W.: On the genesis of the so-called idiopathic esophageal dilatation... 586
- BEUTEL, ALOIS, and MAHLER, PAUL: On the symptomatology and diagnosis of cardiaproximal diverticula of the stomach..... 586
- DILLESEGER: A case of eventration of the diaphragm..... 586
- DIDIÉE: Roentgenography of the thorax in transverse position; normal aspect; pathological images..... 586

### Abdomen

- BLOND, KASPAR: Cholecystography and function of the gall-bladder..... 586

- BAUER, RICHARD, and STRASSE: Cholecystography and liver function..... 587
- COTTONE, G.: Calcareous shadows in the right hypochondrium..... 587
- PICCININO, G.: Right diaphragmatic hernia of the colon..... 588
- CATALANO, ORLANDO: Subphrenic pyopneumothorax from perforation of an ulcer of the colon with roentgen demonstration of the fistula..... 588
- PIGNATARO, E.: The roentgen picture of syphilis of the gastrointestinal tract..... 589
- BRDICZKA, I. G.: Pseudodiverticula of the antrum of the stomach; a roentgen finding in surgically covered perforated duodenal ulcer, and in chronic ulcer with perigastric adhesions..... 589
- DARBOIS and SOBEL: Roentgen examination of a duodenal perforation..... 589
- COTTONE, G.: Diverticulum in a free duodenum..... 589
- TALIA, F.: Tumors of the terminal loop of the ileum..... 590
- HUET, J.-A.: Segmental colitis, an indirect sign of chronic appendicitis..... 591
- DINKIN, L.: Roentgen examination of bleeding affections of the gastrointestinal canal by means of a hydrogen peroxide contrast suspension..... 591

### Genitourinary System

- TEPOSU, E., and ST. JIANU: Intravenous pyelography..... 591
- TURANO, LUIGI: Migrating calculi of the ureter..... 591
- BIANCHINI, A.: A case of almost total calcification of the vasa deferentia..... 591

### Skeletal System

- LACHAPÈLE: Bilateral congenital malformation of the carpal scaphoid (naviculare carpi bipartitum)..... 592
- TEMEL, TARIK: A rare case of congenital malformation of the hand..... 592
- NICOTRA, A.: Humerus varus..... 592
- ARNONE, G.: Biotypy of the skeleton..... 592
- JANKER, ROBERT: The epiphyses of the vertebral bodies and their changes: "persisting epiphyses of the vertebral bodies"..... 592
- BEAN, HAROLD C.: Tuberculosis of the symphysis pubis..... 593







# ABSTRACTS OF RADIUM 1

## ROENTGEN DIAGNOSIS

### HEAD

LASZLO, EDITH. Ein Beitrag zur Röntgen-diagnostik raumbeengender Prozesse in der Schädelkapsel. (Contribution to the roentgen diagnosis of space-narrowing processes in the cranium.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1930, 41, 636-638.

In a patient with increased intracranial pressure a shift (to the right) and a rotation (around its longitudinal axis) of the pineal gland was observed on the roentgenograms taken by the usual technique and it was suspected that the changes were brought about by a brain tumor. The injection of air confirmed the diagnosis. At the post-mortem examination a huge cystic tumor was found. The case is described in order to call attention to the fact that the study of the shadow of the pineal gland may under certain circumstances be of considerable diagnostic value.—*T. Leucutia*.

PESME, PAUL. Étude radiologique d'un cas de maladie de Crouzon. (Roentgen study of a case of Crouzon's disease.) *Bull. et mém. Soc. de radiol. méd. de France*, March, 1930, 18, 149-151.

Crouzon in 1912 for the first time described an interesting and rare affection, so-called hereditary cranio-facial dysostosis, characterized by three cardinal symptoms: (1) cranial malformation; (2) facial deformity, and (3) ocular disturbances.

The author has recently reported 2 similar cases, and in the present article he describes a third. The patient was a girl four years of age who on physical examination presented an oxycephalic cranium (with an eminence in the form of an elongated crest along the sagittal suture), a marked atrophy of the maxillae (with atresia of the nasal fossae and a parrot-beak shaped nose) and a very marked exophthalmos.

The roentgenograms of the skull showed a dome or tiara shaped malformation of the cranial cap with obliteration of the osseous sutures and a hammered (paper thin) appear-

ance of the table. . . ) of the middle fossa with nearly vertical orientation of the sella turcica, and a very marked atresia of the maxillae with diminution of the size of the orbital cavities.

The general condition of the patient was good except for headaches and difficult nasal respiration. The intelligence was normal. No other members of the family were affected. A reëxamination six months later revealed increase in the exophthalmos and a beginning optic atrophy indicating that blindness, which is the most dreaded complication of the disease, had started.—*T. Leucutia*.

### NECK AND CHEST

PODLASKY, H. B., and KOHN, S. E. Thymic shadows of new born infants. *Am. J. Dis. Child.*, April, 1930, 39, 782-789.

Podlasky and Kohn made roentgen examinations of 100 consecutive new-born infants during the first twenty-four hours of life. Although an effort was made, it was not always possible to obtain these pictures in the same phases of respiration. However their technique, they state, remained constant, that is, a distance of 30 inches, one-eighth of a second exposure, at 25 ma. and 55,000 volts. They accepted as their criterion for thymic enlargement, any increase in width of the mediastinal shadow beyond one and one-third times the width of the bodies of the thoracic vertebrae. They quote extensively from the papers of Wasson. They consider the posteroanterior position in recumbency at full inspiration as the best position for examination of the thymus. No mention is made of the lateral position and the possibility of pressure on the trachea by the enlarged thymus as has recently been emphasized by Jackson, Pancoast and Pendergrass.

Of the 100 infants, 35 showed definitely enlarged thymic shadows, that is, the width at the second thoracic vertebra proved to be more than twice that of the latter's transverse diameter. Whether the month of birth has any relation to size of the thymus could not be ascertained as all the infants studied were born during the months from July through November. Sex apparently did not play an



in son the he. gland. utero and difficulties bearing is considered. unanswered questions. occipital anterior position occurred in 13 of the 35 children showing enlarged shadows, the right occipital anterior in 9, the left occipital posterior in 3, the right occipital posterior in 4, breech in 3, and in 3 children the position was not stated. The cry at birth, in spite of the fact that the mother was either partially or completely anesthetized, was vigorous in 26 of the 35 infants; in 2, it was fair, but prompt; in 3 it was poor, and in only 4 was it delayed, and in these instances it was associated with difficulty in resuscitation. Cyanosis was noted in only 2 infants; in one it was marked, and in one, rather slight. In neither instance was it associated with stridor, and in neither instance did it persist. A stridor was noted in but one infant, and it was not associated with any other symptom suggestive of thymic enlargement. Twenty-nine of the 35 infants took food well after the first day; 3, fairly well, and 3, rather poorly. However the primary rise in weight was noted on the second day in 4, on the third day in 12, on the fourth day in 11 and on the fifth day in 2, showing little diversion from the normal. In every instance the child was active and alert and was discharged on or about the tenth day with all evidences of being a normal infant.—*R. S. Bromer.*

CHAUMET, G. Les pleurites et cortico-pleurites apicales. (Pleuritis and apical cortico-pleuritis.) *Bull. et mém. Soc. de radiol. méd. de France*, March, 1930, 18, 111-117.

The author expresses the opinion that the visualization of the apical pleura represents a localized pachypleuritis or cortico-pleuritis. In the initial stage the clinical findings may be entirely negative, while later the lesion is often associated with discrete parenchymal involvement.

The frequent occurrence of adhesions and thickenings of the pleural domes at autopsy supports the theory that apical pleuritis and cortico-pleuritis are more common than hitherto supposed.—*T. Leucutia.*

ARKUSSKY, I. Das Röntgenbild der angeborenen Stenose der Lungenarterie bei

gleichzeitiger Existenz eines Defekts der Kammerscheidewand. (The roentgen image of congenital stenosis of the pulmonary artery with simultaneous defect of the ventricular septum.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1930, 41, 617-626.

Four cases of congenital stenosis of the pulmonary artery cum Roger are described in detail and their clinical and roentgen characteristics discussed.

The conclusion is reached that the orthodiagraphic study of the configuration of the heart in various positions is of great aid in establishing a correct diagnosis.

It is interesting that in all instances there was a remarkable functional adaptation of the heart, maintaining a practically normal circulation. However, as soon as pulmonary complications arose the heart failed to produce proper compensation and 2 of the patients died. In the 2 others pulmonary lesions have appeared more recently and it is doubtful whether they will survive. Thus the prognosis in congenital stenosis of the pulmonary artery cum Roger must remain serious.—*T. Leucutia.*

GALIFI, LIBORIO. La linea capillare nel campo polmonare destro. (The capillary line in the right lung field.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 132-145.

Not infrequently roentgenograms of the thorax show a delicate opaque line passing through the middle of the right lung field, generally transversely, sometimes obliquely at a level between the second and fourth ribs. It is a very delicate capillary line and is to be differentiated from much heavier and irregular lines sometimes seen which are due to definite interlobar pleurisy and from a subcapillary line demarcating an azygos lobe. The differentiation between the latter line and the capillary line in question is sometimes difficult. While it is generally recognized that the large and subcapillary lines represent pathological conditions of the interlobar fissure there has been a great deal of discussion as to whether the capillary line represents a beginning interlobar pleurisy or merely a normal incisure. The frequency with which it is found in apparently normal thoraces would argue in favor of the latter supposition. It is further supported by the fact that these capillary lines are rarely seen in children under five years of age. This brings up the question of whether the line is



to be considered pathological only in young children. It would be an interesting study to determine whether there is any relation between the capillary line and primary tuberculous infection in early childhood. The author describes 5 cases in which the capillary line was seen in roentgen examination of the thoraces of young children. The first 3 had definite lung and gland tuberculosis while the other 2 showed lung lesions suspicious of tuberculosis. The cases are too few to be conclusive but the author thinks them suggestive.—*Audrey G. Morgan.*

BUSI, A., and PAOLUCCI, R. Indagini sulla percentuale di tubercolosi latenti e di complessi primari accertabili radiologicamente tra la popolazione infantile di una zona rurale. (Percentage of latent tuberculosis and primary complexes demonstrable roentgenologically in the children of a rural district.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 126-131.

The authors studied 292 children from six to nine years of age in a rural district. They tried to find out the family history, the possible conditions of contagion, the constitutional characteristics, the method of feeding during nursing and weaning, the habits of life, hygiene of the dwellings, etc. They measured weight, height and circumference of the thorax. They found the measurements defective in 66.1 per cent of the cases, which they attribute to the poverty of the families. They found that 64.9 per cent of the children with lesions that could be demonstrated roentgenologically belonged to families with a history of tuberculosis. In 60 per cent of the cases there was a history of measles, in 50 per cent of whooping cough, in 20 per cent of influenza, in 12 per cent of pneumonia, in 1 per cent of pleurisy and in 75 per cent of ascariasis. In 25 per cent there were adenoids, in 40 per cent enlarged cervical glands and in 37 per cent general enlargement of the glands. The gland enlargements were not specific.

The technique used in the roentgen examinations was: Coolidge tube, Cardolle apparatus, focus skin distance 80 cm., 60 ma., spark gap 8-9 cm.; 1/10 to 1/20 second exposure, ventral decubitus, inspiratory apnea. Films 24×30 were used so that the subdiaphragmatic region could also be examined.

The lesions seen in tuberculosis in childhood are: Ranke's primary complex, perifocal inflammation, subacute miliary tuberculosis,

chronic tuberculosis and progressive pleural lesions. The authors did not find any cases belonging in the 3d and 4th of these groups. The primary complex may escape detection because it is small and not very dense. They found 2 active cases in the form of small caseous masses with enlargement of the tracheobronchial glands, which in 4 cases were calcified; in 2 cases there was only enlargement of lymph glands and in 4 cases only calcification of solitary hilus glands. Perifocal inflammation is an inflammatory infiltration around a tuberculous focus. They found it in 4 cases. They found plastic pleurisy in only one case.

There were tuberculous lesions definitely demonstrable roentgenologically in 6.5 per cent of the cases, and suspicious signs in 4.1 per cent, making a total of 10.6 per cent. There were definitely positive tuberculin reactions in 12.5 per cent of the cases and, including the suspicious ones, in 21 per cent of the cases. The authors conclude that roentgen examination may show tuberculous lesions before clinical examination does.

They emphasize the importance of making a roentgen examination of the thorax in children the first year they begin school and one every year after that so as to determine the roentgen anatomy of the respiratory tract and heart with relation to the region in which the child lives, his constitution and progressive development up to puberty. This, in connection with the personal and family history and physical examination would give a thorough knowledge of tuberculosis in childhood, its aggravation after certain infections and the nature of the first manifestations of tuberculous reinfection.—*Audrey G. Morgan.*

ST. DEDIĆ. Cor bovinum in der Differential-diagnose. (Differential diagnosis of cor bovinum.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1930, 41, 589-597.

Cor bovinum, although it represents a general enlargement of the heart, on closer analysis usually reveals signs which permit the recognition of the fundamental organic lesion (mitral, aortic, tricuspid insufficiency, etc.). As a rule no great difficulty is encountered in making a correct diagnosis.

When the enlarged heart shadow, however, is due to the presence of fluid within the pericardium, the problem may become very complex. After describing 8 cases more or less in detail, the author arrives at the conclusion



that the following signs are of particular value: A cor bovinum shows only slight variation in the form and position of the heart in serial orthodiagraphy, while in pericardial effusions this may be considerable (especially when changing the position of the patient). If the exudate or transudate exceeds the amount of 1 liter the heart assumes a tobacco pouch appearance, while in exudates of moderate amount (0.5 liter) it becomes triangular and in transudates of moderate amount (0.5 liter) it conforms to the configuration of the pathological heart.—*T. Leucutia.*

VISCHIA, QUINTINO. Studio radiologico e clinico sui rapporti tra vizii mitralici e tubercolosi polmonare. (Roentgen and clinical study of the relation between mitral lesions and pulmonary tuberculosis.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 11-20.

It is an old belief that there is an antagonism between acquired heart lesions and tuberculosis, and particularly between mitral lesions and tuberculosis. The author reviews the literature of the subject and has found from his own work that the coexistence of mitral lesions and pulmonary tuberculosis is not infrequent. He has seen both stenosis and insufficiency of the mitral valve in tuberculosis. Illustrative roentgenograms are given.—*Audrey G. Morgan.*

BÁRSONY, THEODOR, and KOPPENSTEIN, ERNST. Lobus apicodorsalis (eine bisher unbekannte Lokalisation des Azygoslappens). (Lobus apicodorsalis, a hitherto unknown localization of the azygos lobe.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, March, 1930, 41, 459-466.

The authors observed an unusual appearance of the azygos lobe in 3 (later 4) cases. In the posteroanterior view there was evidence of a slightly convex linear shadow in the region of the right apex which on examination in the lateral view (according to the authors' technique) proved to be the roentgen expression of the lower border of the azygos lobe. Since the condition is localized posteriorly and to the apex of the lung the name of lobus apicodorsalis is suggested. In the lateral view, this lobe appears oval shaped, the long axis forming an angle of 45° with the vertebral column.—*T. Leucutia.*

AIRALE. Echinococcosi polmonare secondaria e sedi di sviluppo. (Secondary echinococcus of the lung and its site.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 150.

Some authors say that the site of predilection of secondary echinococcus cyst of the lung is the lower lobe because from a primary localization in the liver the organisms pass through the diaphragm into the lower lobe of the right lung. Others say that the site may be anywhere in the right lung because of the larger caliber of both the vessels and bronchi. But surgical findings have shown that echinococcus cysts may develop in either the right or left lung. The author presented a case of diffusion through the bronchi of many small daughter cysts implanted in different lobes of the lung as a result of spontaneous rupture of an echinococcus cyst at the hilus. But this method of diffusion is not frequent, as shown by another case of spontaneous rupture of an echinococcus cyst in a lobe of the lung which did not result in dissemination.—*Audrey G. Morgan.*

DELHERM and MOREL-KAHN. Diagnostic des tumeurs du poumon chez l'adulte. (Diagnosis of tumors of the lung in the adult.) *J. de radiol. et d'électrol.*, March, 1930, 14, 158-169.

The authors discuss the diagnosis of intrathoracic tumors from the point of view of their roentgen appearance. Two main groups are distinguished: (1) tumors showing a rounded, and (2) tumors showing an irregular appearance. In the first group differential diagnosis includes pulmonary abscess, encysted pleural effusion and aneurysm of the aorta. The tumor may be benign (dermoid cyst, fibroma, hydatid cyst) or malignant (sarcoma, primary carcinoma). In the second group the following forms are distinguished: (a) lobar form (differential diagnosis including tuberculosis); (b) juxta mediastinal forms (differential diagnosis including pulmonary sclerosis, mediastinal tumor, tuberculous hilar adenopathy); (c) mediastino-pulmonary forms (differential diagnosis including massive tuberculosis); (d) cavitary forms (differential diagnosis including pulmonary cavity and abscess), and (e) pleural form (very rare).

In most instances the roentgen examination must be supplemented with clinical procedures (exploratory puncture, demonstration of en-



largement of the adjacent lymph nodes), surgical exploration (biopsy), and the so-called roentgen therapeutic test dose, in order to arrive at a correct diagnosis.—*T. Leucutia.*

BAUERMEISTER, W. Zur Genese der sog. idiopathischen Ösophagusdilatation. (On the genesis of the so-called idiopathic esophageal dilatation.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1930, 41, 626-630.

Esophageal dilatation may be divided into two stages, each of which comprises two phases. In the first phase of the first stage there is evidence of esophageal atony with delayed passage of the opaque medium. In the second phase of the first stage (classical phase) there is paralysis of the esophagus and a spasm of the cardiac end, reaching, as a rule, above the diaphragm. In the first phase of the second stage there is evidence of residue with gradual dilatation of the esophagus reaching below the diaphragm, and in the second phase of the second stage there is an enormous dilatation and elongation of the entire esophagus.—*T. Leucutia.*

BEUTEL, ALOIS, and MAHLER, PAUL. Zur Symptomatologie und Diagnose der kardianen Magendivertikel. (On the symptomatology and diagnosis of cardiaproximal diverticula of the stomach.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1930, 41, 630-635.

Two procedures are of special value in the diagnosis of diverticula of the cardiac end of the stomach: (1) the roentgen study of the relief of the mucous membrane and (2) the direct gastroscopic examination.

For the demonstration of the folds of the mucous membrane, it is best to administer a thick barium mixture and after this has entered the diverticular sac to express the contents of the sac by manipulation and placing the patient in the most favorable position. Differential diagnosis includes niche, carcinoma crater and hernia of the esophageal hiatus.

The gastroscopic examination is done directly and the appearance of the folds leading to the diverticular opening is studied. The differential diagnosis here includes niche and spastic contractions.—*T. Leucutia.*

DILLENSEGER. Un cas d'événement diaphragmatique. (A case of eventration of the

diaphragm.) *Bull. et mém. Soc. de radiol. méd. de France*, March, 1930, 18, 89-94.

The case was easily differentiated from a true diaphragmatic hernia due to the fact that the diaphragm appeared above the gastric shadow, while in hernia the stomach enters through the diaphragm into the thoracic cavity. There was a marked elongation of the mesoduodenum. This, together with the rudimentary appearance of the left lung and dextrocardia, suggested that the condition was of a congenital nature.—*T. Leucutia.*

DIDIÉE. Radiographie du thorax en position transverse: Aspect normal. Images pathologiques. (Roentgenography of the thorax in transverse position; normal aspect; pathological images.) *Bull. et mém. Soc. de radiol. méd. de France*, March, 1930, 18, 101-106.

The author discusses in detail the roentgen appearance of the chest in the true lateral position and arrives at the conclusion that the method is of great value in the study (1) of organs permitting demonstration by opaque media; (2) of isolated or associated pleural and intrapleural processes; (3) of the mediastinum and hila, and (4) of the heart and especially great vessels.—*T. Leucutia.*

ABDOMEN

BLOD, KASPAR. Cholezystographie und Funktion der Gallenblase. (Cholecystography and function of the gall-bladder.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1930, 41, 571-581.

The author, after discussing the various theories of the function of the gall-bladder arrives at the conclusion that the assumption that the gall-bladder empties (through the cystic and common duct) into the duodenum is erroneous. The following facts are cited in support of this view: (1) the presence and structure of Heister's valves; (2) the peculiar blood supply of the gall-bladder (the cystic vein opens into the portal vein); (3) the fact that no instance is known in which a fluid can flow in two directions at the same time; (4) the mucous membrane of the gall-bladder is provided with epithelium which absorbs not only water, salts and dyes, but all other substances of the bile; (5) the gall-bladder possesses only



... and ...  
... of ...  
... (Mac ...  
... humans, part  
... added within  
... the liver, a circumstance  
... actual contraction.

The functional method by duodenal aspiration does not prove motility of the bile ducts but is simply a functional test of the liver. This is true also of cholecystography. The present interpretations of cholecystograms are based on the assumption that the cystic duct represents the outlet of the gall-bladder, while the outlet really is the cystic vein. The emptying of the gall-bladder following the administration of egg yolk is explained through a retrograde resorption of the bile from the gall-bladder into the liver, there being at the same time a marked absorption through the mucosa of the gall-bladder. The author therefore expresses the opinion that a further study of the physiologic processes of the bile system is necessary before one will be able to arrive at a proper interpretation of the roentgen findings in cholecystography.—*T. Leucutia.*

BAUER, RICHARD, and STRASSER, ULRICH.  
Cholecystographie und Leberfunktion. (Cholecystography and liver function). *Klin. Wchnschr.*, March 15, 1930, 9, 487-491.

More recently Graham has introduced the use of the isomer phenoltetraiodophthalein for the liver function test in connection with cholecystography. A retention of 14 per cent of the dye in the blood serum half an hour and 4 per cent one hour following the intravenous injection indicates a normal function, while a greater concentration is indicative of some pathological condition.

The author expresses the opinion that a dye cannot be used for the determination of the liver function for the simple reason that the excretion of the dye through the liver depends on the following five factors: (1) the type of biliary flow in the intra- and extrahepatic gall ducts; (2) the function of the reticulo-endothelial system; (3) the function of the liver cells; (4) the general and hepatic blood supply and (5) the amount of reabsorption of the dye excreted with the bile into the intestinal tract.

In order to check up on the above more or less theoretical considerations, the author en-

gaged in a series of experiments by administering the dye by the oral method and by injecting at the time of the first roentgenogram 350 mg., that is, 5 c.c. of a 7 per cent solution of phenoltetrachlorophthalein (chlor-choleognostyl Gehe) intravenously, the blood being examined two hours later for the retention of the dye. The percentage of the retention was then checked against the cholecystographic findings as well as against the galactose, icteric and diazo tests of the blood serum and against the quantitative bilirubin and urobilinogen tests of the urine.

The series included 125 cases, 21 of which were cases with icterus catarrhalis. Eight of these, as well as one of salvarsan icterus, were studied for a longer period and their findings were tabulated.

It was found that the cholecystographic visualization of the gall-bladder (by the oral method) depends on the dye excretion of the liver, which in turn is dependent on the normal biliary excretion. Thus in icterus catarrhalis (during the clearing up phase) and especially in nonicteric cirrhosis of the liver, in spite of a marked galactosuria, the dye excretion remained practically normal and a good gall-bladder shadow was obtained. Only in case of complete or nearly complete icterus was there nonfilling of the gall-bladder. In nonicteric diseases the lack of filling of the gall-bladder did not always indicate a disturbance of the liver function. Thus in diabetes mellitus, morbus Basedowii and nonicteric liver cirrhosis, there was often non-filling of the gall-bladder, the reason for this remaining entirely unexplained.

The conclusion is reached that the liver function test in conjunction with cholecystography (oral method) is of little clinical value. In exceptional nonicteric cases as, for example, atrophic cirrhosis, amyloid and fatty degenerations, etc., cholecystography may eventually be combined with the cholegnostyl test. If the retention (at two hours) does not exceed 15 per cent one may expect a normal gall-bladder shadow.—*T. Leucutia.*

COTTONE, G. Ombre di tinta calcare nell'ipocondrio destro. (Calcareous shadows in the right hypochondrium.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 233-234.

The author demonstrated a case in which the roentgenogram of an adult man showed two spots the size of filberts in the liver shadow.



The patient had been admitted with the clinical diagnosis of chronic purulent cholecystitis. The two shadows were made up of concentric stripes, calcareous stripes alternating with transparent ones. They were in the ventral plane, moved with the liver shadow on respiration and the distance between them remained constant. They could not be displaced laterally. Operation showed cholecystitis and showed that the shadows were caused by two little tumors just beneath Glisson's capsule on the posteroinferior surface of the liver, one near the lower border, the other near the hilus. Histological examination showed that they were calcified echinococcus cysts.—*Audrey G. Morgan.*

PICCININO, G. Ernia diaframmatica del colon. (Right diaphragmatic hernia of the colon.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 150-164.

Roentgen examination has shown that diaphragmatic hernia is more frequent than it was formerly supposed to be. It has also shown that traumatic hernia is relatively rare in comparison with the congenital form. The hernias may be divided into true ones with a sac and false ones without a sac. The hernia may take place either through a normal opening in the diaphragm or through a congenitally weak spot.

A case is described in a man of twenty-eight who had always been well. After an emotional disturbance he had constipation and abdominal pain. As purgatives had no effect on the constipation and the pain grew worse a physician was called in who made a diagnosis of appendicitis. After six or seven days the pain passed off and the patient was sent for roentgen examination, not for confirmation of the diagnosis but to determine whether operation was necessary. Roentgen examination showed a part of the colon in the thorax. A barium enema rose into the part of the colon in the thorax and returned to the abdominal part. The part of the colon that remained in the abdomen was in the shape of a reversed V. The thoracic part of the colon lay to the right of the midline. It was a parasternal hernia passing through one of the congenitally weak points in the diaphragm. This variety of parasternal hernia is quite rare. Such hernias may exist for a long time without causing any symptoms at all. But the attack of pain in this case shows that such a patient is always in danger. But notwithstanding all the improvements in surg-

ery, operation for diaphragmatic hernia is free enough of danger to be recommended for a perfectly healthy subject. The thing to do is to keep the patient under observation and be ready to operate at the first complications.—*Audrey G. Morgan.*

CATALANO, ORLANDO. Piopneumotorace destro con dimostrazione radiologica del tragitto fistoloso. (Subphrenic pyopneumothorax from perforation of an ulcer of the colon with roentgen demonstration of the fistula.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 165-176.

A man of forty-three had a history of attacks of abdominal pain for about twenty years. He had been able to control it by diet and had not had constipation or icterus. About two weeks before examination he suddenly had intense pain in the epigastrium after a rather heavy meal with vomiting and rigidity of the wall of the abdomen. He had constipation for several days and after that tarry stools. After a few days his condition improved. He had only had moderate fever but after about two weeks, on the day that he came to the author for examination, he had an attack of fever preceded by a chill. Roentgen examination showed an area of air and liquid in the outer half of the right hypochondrium; in the lower part of it there was a liquid level that moved readily when the patient moved. All the right border of the liver appeared to be detached from the wall of the abdomen as if artificial pneumoperitoneum had been performed. The picture was very similar to that in perforation of the stomach and duodenum but examination showed that these organs were normal. Some days later an enema was given and at the hepatic angle of the colon a part of the barium passed through a fistula to the accumulation of air and liquid mentioned above. The fistula was still partially visible after twenty-four hours. Surgical operation was performed and punctures made at the site of the accumulation of gas. It was thought best not to open the peritoneum for fear of disseminating the infection. A small amount of purulent liquid and a little gas was removed. The fever fell after the operation and the patient's general condition improved. But later fluid formed in the right pleura which had to be removed. The author thinks the perforation was produced by a simple ulcer of the colon.—*Audrey G. Morgan.*



PIGNATARO, E. La radiologia nella sifilide del tubo gastro-enterico. (The roentgen picture of syphilis of the gastrointestinal tract.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 1-10.

The roentgen picture of syphilis of the stomach is variable and confused because syphilitic tissue is constantly dying and being regenerated. The author describes 2 clinical cases in one of which the picture suggested ulcer and in the other stenosis of the pylorus. He reviews the literature on the subject of the roentgen findings in syphilis of the stomach and concludes that it is often mistaken for that of ulcer or carcinoma. As the picture of syphilis is variable and not characteristic it may readily be mistaken for that of other lesions. If the therapeutic test for syphilis were tried before operation for such conditions it would save many patients from operation who are operated on merely on Haudek's syndrome.—Audrey G. Morgan.

BRDICZKA, I. G. Antrum-Pseudodivertikel des Magens, ein Röntgenbefund bei operativ gedecktem *Ulcus duodeni perforatum* sowie chronischem *Ulcus* mit perigastrischen Adhäsionen. (Pseudodiverticula of the antrum of the stomach; a roentgen finding in surgically covered perforated duodenal ulcer, and in chronic ulcer with perigastric adhesions.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, March, 1930, 41, 384-392.

Seven cases of pseudodiverticula of the antrum of the stomach (4 of which were confirmed at operation) are briefly described and their roentgenograms presented.

The conclusion is reached that the pseudodiverticula of the antrum may be the result of the surgical covering of perforated duodenal ulcers by a flap of omentum or of certain chronic ulcers resulting in very extensive perigastric adhesions.

Differential diagnosis includes prepyloric ulcers with spasm of the greater curvature. The constant absence of the niche, the lack of sensitiveness on pressure, a peristalsis of the prepyloric pocket and a two-hour residue in the pocket make the diagnosis of pseudodiverticulum of the antrum rather certain. In a few instances it is necessary to use atropinization. From a practical standpoint one may say that (1) if a pseudodiverticulum of the antrum is accompanied by marked deformity

of the bulb, a prepyloric ulcer can be ruled out with certainty; (2) if a pseudodiverticulum is accompanied by only a slight deformity of the bulb the possibility of a duodenal ulcer must be considered, and (3) if the bulb is entirely normal the pseudodiverticulum is most probably the result of a spastic contraction of the antrum from a prepyloric ulcer.—T. Leucutia.

DARBOIS and SOBEL. Note sur l'examen radiologique d'une perforation duodénale. (Roentgen examination of a duodenal perforation.) *Bull. et mém. Soc. de radiol. méd. de France*, March, 1930, 18, 85-89.

A case of duodenal ulcer with perforation is described in a man thirty-five years of age who came to roentgen examination with rather vague symptoms, no perforation having been suspected.

The following three roentgen signs were of special value: (1) the coexistence of a typical duodenal ulcer with an atonic, immobile, fixed stomach (although this appears paradoxical since one would expect hyperkinesia with spasticity of the pylorus); (2) the presence of gas around the duodenum (in the authors' case a drop of barium passed into the peritoneal cavity); (3) the presence of gas in the peritoneal cavity, especially underneath the diaphragms. In connection with this latter sign, it is advised that if no air can be demonstrated in the peritoneal cavity, the patient be placed on the left side for a period of thirty to forty minutes and then reexamined. A small quantity of air will pass into the peritoneal cavity, even in very small perforations.

The author performed a number of experiments in cadavers by forcing air into the stomach by means of a Faucher tube, and by perforating the duodenum with a stylet through the abdominal wall. Air passed most freely into the peritoneal cavity when the cadaver was placed in the left lateral position.—T. Leucutia.

COTTONE, G. Diverticolo duodenale in duodeno libero. (Diverticulum in a free duodenum.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 177-180.

There is a great deal of literature on diverticula of the duodenum and also on abnormalities in the position, direction and length of the different sections of the duodenum, but the author has never seen a report of a case in which the



two abnormalities were combined. He describes and presents roentgenograms of a case in which the first portion of the duodenum was normal in site, shape and direction; the second part descended obliquely and a little to the right; this was followed by a tract on the right which showed a coil like a loop of mesentery. In this tract there was a diverticulum the size of an apple. Its walls did not show any peristalsis but its mouth opened and closed like a sphincter. Nine hours after the barium was taken the diverticulum alone could be seen at the level of the 4th lumbar and a little to the left of the midline. The patient was a man of fifty who had never had any illness except that he had had icterus for about three weeks while in military service in 1915. He had often had acidity and this had recently increased in frequency, intensity and duration, accompanied by epigastric pain such as that usually seen in ulcer of the duodenum. A few days before the examination his stools had for the first time presented a coffee-ground appearance. There were no signs of ulcer elsewhere in the digestive tract and the author concludes that this was a case of ulcer in a duodenal diverticulum in a free duodenum. He thinks there is no doubt that the diverticulum was a true congenital one.—*Audrey G. Morgan.*

TALIA, F. Sui tumori dell'ansa terminale dell'ileo. (Tumors of the terminal loop of the ileum.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 180-183.

Tumors of the terminal loop of the ileum are unusual. From 1925 to 1929 the author has seen 9 cases, 2 of sarcoma, 2 of carcinoma, 1 syphilitic, 2 tuberculous and 2 inflammatory. The 2 cases of sarcoma were in patients fourteen and twenty years of age and were controlled by operation. In the first the roentgen signs were characteristic of stenosis of the intestine with a defect in filling not far from the ileocecal valve. In the other the stenosis was more intense. There was a thin strip of barium joining the terminal loop of the ileum and the ileocecal valve. The tumor was very large and palpable clinically, while roentgen examination showed the cecum dislocated upward and deviated by compression of the tumor above it.

Of the 2 cases of carcinoma the first was in a patient of thirty-seven and secondary to a carcinoma of the cervix of the uterus in a patient who had had radium and roentgen treatment for the primary tumor. Roentgen

examination showed the form of the terminal ileum and the cecum. There was a slight narrowing of the terminal ileum and two different zones of the terminal ileum far from the ileocecal valve. In the second case in a man of fifty, the filling defect was small. There was no history of a primary tumor elsewhere; the patient refused operation. Now two months after the roentgen examination he is in serious condition with cachexia.

The first of the two cases of tuberculosis was in a man of thirty-one with open pulmonary tuberculosis. Recently he had begun to show signs of stenosis, while palpation showed a hard irregular mass. Roentgen examination showed a distinct gap between the ileum and ascending colon while only the bottom of the cecum filled; in addition to this irregularity, there were all the roentgen signs of stenosis. This patient was greatly improved after two months of roentgen treatment. The other case was in a woman of twenty-two. Clinically there were all the signs of intestinal tuberculoma and roentgenologically there was a distinct gap between the terminal ileum and the cecum. Operation showed a mass of hyperplastic glands involving the terminal ileum and extending to the right adnexa.

The syphilitic case was in a woman of thirty-nine in whom syphilis had been demonstrated clinically, serologically and roentgenologically. Roentgen examination showed a thin strip of barium uniting the terminal part of the ileum with the colon; functionally there was retardation in the passage of the barium meal and absence of peristalsis. The loop above showed some dilatation.

The first patient with an inflammatory tumor, a man of thirty-two, had had a trauma with severe entorrhagia. After some years two palpable tumors developed, one in the umbilical region and the other on the right. They increased slowly in size without causing any symptoms. Roentgen examination showed a stenosis of the jejunum and a second more serious stenosis of the terminal ileum at the site of the two tumors. The loops of intestine were dilated and showed active peristalsis; the movement of the barium was slow and there were filling defects. In the other case there was extreme stenosis of the terminal ileum. Operation showed tumor of the terminal ileum and histological examination showed that it was inflammatory in nature.—*Audrey G. Morgan.*



and lower margins of vertebral bodies, best visualized in the anterior view, completing the usual rectangular form of the bodies of the vertebrae affected. Differential diagnosis includes bone splinters, arthritic changes and abnormal calcifications of the intervertebral discs.

The author describes briefly 7 cases of "persisting epiphyses of the vertebral bodies" which he has observed during the past few years in a series of 750 spinal examinations.—*T. Leucutia*.

BEAN, HAROLD C. Tuberculosis of the symphysis pubis. *J. Bone & Joint Surg.*, April, 1930, 12, 345-352.

The author reports a case of tuberculosis of the symphysis pubis. He reviews the literature, and concludes from his analysis of the reported cases that tuberculosis may appear in the symphysis pubis at any stage of life, that sex does not have any bearing on its occurrence, that two rather constant findings occur, an irregular gait and a tumor mass. This mass may appear in the upper thigh or be localized about the symphysis. When a fistula appears the diagnosis is rather easy.

In his case report he gives no illustration of the roentgenogram of the lesion which he describes as a definite destructive lesion in the left symphysis. It was impossible to say whether this was due to osteitis fibrosa with a cyst or to tuberculous disease. His experience in this case leads him to say that in all cases of sacroiliac lesion, inguinal pain, lower abdominal and upper thigh tenderness, roentgenograms of the symphysis pubis should be included in the examination before treatment is considered; that in cases where there are acute symptoms, curettage should be instituted, with fixation when the wounds are healed.—*R. S. Bromer*.

HELLNER, HANS. Spondylolisthesis, traumatische Sub- bzw. Totalluxation in der Lumbosakralregion und sogenannte Präspandylolisthesis. (Spondylolisthesis, traumatic sub- and total luxation in the lumbosacral region and so-called prespondylolisthesis.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1930, 41, 527-549.

On the basis of a review of the literature as well as of several of his own cases, the author makes the following distinctions between the various lesions of the lumbosacral region: (1) The term spondylolisthesis should be ap-

plied only to cases on a congenital basis. The traumatic sub- and total luxations must be separated from spondylolisthesis for the following reasons: (a) a subluxation never leads to a complete slipping of the vertebrae; (b) spondylolisthesis contrary to traumatic subluxation, is presumably congenital and (c) it does not imply the presence of trauma as an etiologic factor. Traumatic subluxations are more frequent than congenital spondylolisthesis. The American literature includes both conditions under the term of spondylolisthesis, although their separation is important also from a medicolegal standpoint.

(2) The subluxation of a vertebra due to tuberculosis, tabes, and spondylitis deformans, should not be included within the spondylolisthetic group for the simple reason that here the destruction of an intervertebral disc is the primary provoking factor.

(3) A lumbosacral angulation which is smaller than  $120^\circ$  (determined by Junghann's procedure) may produce sacral pain.

Lumbosacral lordosis with normal or slightly increased inclination of the pelvis and without functional disturbance often occurs on a constitutional basis. Here the lumbosacral angle is likewise smaller and there is nearly horizontal position of the sacral bone, resulting in the so-called pointed sacrum of Scherb. This condition does not represent a preliminary stage of spondylolisthesis and consequently its designation as pre-spondylolisthesis should be abandoned.

The changes in the lumbosacral region can thus be briefly classified as follows: (a) spondylolisthesis on a congenital basis; (b) traumatic sub- and total luxations on a traumatic basis, and (c) increased lumbosacral lordosis (among them chiefly the pointed sacrum of Scherb) on a constitutional basis.—*T. Leucutia*.

SCHMORL, GEORG. Die Pathogenese der juvenilen Kyphose. (The pathogenesis of juvenile kyphosis.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, March, 1930, 41, 359-383.

Juvenile kyphosis is the result of a hemispherical protrusion of the nucleus pulposus into the spongiosa of the bodies of the vertebrae occurring chiefly in the mid- or lower dorsal region.

The primary cause is most probably a splitting of the cartilaginous plates (due to traumatic injury or congenital anomalies). Later an endochondral growth of the cartilaginous



If a person afflicted with a kyphosis must perform heavy labor during the second period of growth, the kyphosis may become very pronounced, whereas if the stress on the intervertebral discs is less, the kyphosis may be only moderate or entirely absent.

The changes of the juvenile kyphosis are so characteristic that a differential diagnosis from other forms of kyphosis (rickets, osteomalacia, osteoporosis, trauma, infection) as a rule does not encounter great difficulties. Moreover, because of the rather permanent nature of the changes produced, the juvenile origin of the kyphosis can be recognized even in later life.

The article is illustrated with numerous photographs and roentgenograms of anatomic sections and with several interesting photomicrographs.—*T. Leucutia*.

CALVÉ, JACQUES, and GALLAND, MARCEL. Le nucleus pulposus intervertébral; son anatomie, sa physiologie, sa pathologie. (The intervertebral nucleus pulposus; its anatomy, physiology and pathology.) *Presse méd.*, Apr. 16, 1930, 38, 520-524.

A. Anatomy. The intervertebral disc consists of the nucleus pulposus and annulus fibrosus and of the superior and inferior cartilaginous plates. The nucleus pulposus is situated in the center, or more frequently at the margin of the middle and posterior thirds of the intervertebral disc.

B. Physiology. The nucleus pulposus which is under pressure acts as a spring pushing one vertebra away from the other. In addition to this, it is a shock absorber acting as a veritable ball bearing.

C. Pathology. In this group are included not only the primary lesions of the disc but all those in which the nucleus pulposus has a particular rôle. They are: (1) Calcification of the nucleus, which is exceedingly rare, and is characterized on the roentgenograms by a homogeneous oval shadow corresponding to the site of the nucleus pulposus. Its clinical significance is not as yet clear. (2) The posterior displacement of the nucleus (Galland). (a) This often occurs secondarily in developmental anomalies of one of the vertebrae (absence of ossification of the anterior epiphysis). The adjacent superior and inferior vertebral segments incline on the affected vertebra, thus leading to posterior displacement of the nucleus pulposus with sub-

sequent protrusion of the nucleus into the spinal canal. (b) This occurs in cases of which the nucleus is displaced posteriorly, causing a protrusion of the nucleus into the spinal canal, especially in the dorsolumbar and lumbosacral regions, pressing on the spinal cord. Clinically this condition is characterized by localized kyphosis and paraplegia. (3) The bowl-shaped discs (usually associated with osteoporosis) consisting in a peculiar spherical or ovoid enlargement of the intervertebral discs with corresponding decrease in the size of the vertebral bodies (typical biconcave lenticular aspect). This condition is observed in post-puerperal malacias, in children with generalized osteomalacia, in hunger osteomalacias (in Germany shortly after the war) and in certain localized osteoporoses (of neoplastic or Paget origin). (4) The intraspinal nuclear hernias, studied in detail by Schmorl. There is a protrusion, usually symmetrical, of the nucleus pulposus into the spongiosa of the adjacent vertebrae, forming veritable hernias of various size and form (strawberry, raspberry, creeping caterpillar). The condition occurs in 38 per cent of all the examined spines. The chief lesions leading to intraspinal hernias are: (a) the painful kyphosis of adolescence (between fourteen and eighteen years) which occurs chiefly in the mid-dorsal region; (b) the kyphosis with indented discs, the so-called epiphysitis (although the author is of the opinion that the term epiphysitis should be reserved for designation of those lesions in which the intervertebral disc is of normal appearance and the lesion is confined only to the site of the epiphysis), and (c) other kyphoses with a roentgen appearance similar to that of the kyphosis with indented discs but of a more complex character. The nature of these latter has not as yet been sufficiently studied.

There is no doubt that the pathology of the intervertebral discs plays a very important part in the pathology of the spinal column as a whole.—*T. Leucutia*.

TURANO, LUIGI. Di un aspetto radiografico raro di vertebra dorsale. (An unusual appearance of a dorsal vertebra.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 75-79.

An examination of the urinary tract was made in a woman of thirty-five. The pictures did not show anything abnormal there but the



showed a peculiar striation of the vertebral body stripes running down the center of the body. The lateral anastomosis of the body was normal. It was in the region of the sacrum. There were no symptoms referable to the spinal column and sensation and motion were normal. The cause of this peculiar appearance is not known. It may have been a congenital bone lesion. There was a moderate degree of scoliosis with the concavity to the right.—Audrey G. Morgan.

NICOTRA, A. Di una bandaletta ossea sacrolombare anomala in casi di sacralizzazione della ventiquattresima vertebra. (An anomalous sacrolumbar band of bone in cases of sacralization of the 24th vertebra.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 81-93.

Two cases are described, the first in a man of fifty-eight who from time to time had lumbosciatic pain with irradiation along the branches of the sciatic on both sides. Sometimes the pain was almost unendurable and prevented walking. The roentgenogram showed an extreme degree of sacralization of the fifth lumbar and diffuse osteoarthritis of all the lumbo-sacro-iliac tract. There were two bands of bone, one on each side, connecting the fifth lumbar with the sacrum. Above, the bands were implanted on the posterior surface of the costiform process of the fifth lumbar at the site of the accessory tubercle; below, on a spine at the posterior margin of the wing of the sacrum, on the prolongation of the crest of the conjugate tubercle. The intervertebral space between the costiform process of the fifth lumbar and the sacrum had disappeared. There were two supernumerary sacral foramina.

The second patient was a woman of fifty-nine who had had chronic dorsal and lumbar arthritis for many years which radiated to the gluteal region and along the branches of the sciatic and interfered with walking. The roentgen examination showed a high degree of bilateral sacralization of the fifth lumbar with signs of diffuse osteoarthritis of all the lumbosacral tract. In this case there was a band of bone, similar to those in the above case, but only on the right side.

These bands are always seen in a high degree of sacralization of the fifth lumbar, though the bands are not themselves necessarily bilateral. In some cases only the upper part of the band is visible. These bands are commonly said to

be due to calcification of the ligaments. The author shows by a discussion of the ligamentous position of the ligaments that this cannot be so. He thinks that the upper part of the band comes from a unilateral or bilateral styloid process and the lower part from the upper half of the conjugate tubercle of the sacrum. The bands therefore are homologous morphogenetically with the conjugate tubercle of the sacrum.—Audrey G. Morgan.

FRANCESCO, G. Contributo clinico-radiologico alle spondiliti infettive. (Clinical and roentgen study of infectious spondylitis.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 94-111.

Four cases are described with illustrative roentgenograms. The patients were thirty-five or more years of age. *Staphylococcus pyogenes aureus* is almost always the cause, more rarely *pyogenes albus*, very rarely the streptococcus. The disease begins suddenly and violently, and its course is long and serious. The septic focus in the spinal column may be primary, in which case pain in the spinal column with spasm of the cervico-dorso-lumbar muscles and the rigidity of the spinal column, which may extend to opisthotonos, suggest meningitis. If the focus in the spinal column is secondary there may be a longer or shorter course with fever of a septicemic type that suggests typhoid. Lumbar puncture will help to clear up the diagnosis. In the septicemic cases the diagnosis cannot be made until there are some spinal symptoms. If the defensive forces of the body are good there may be periods of improvement or apparent cure but the attacks will recur.

Roentgen examination in the period of defervescence shows beginning changes in the bones. The outlines of the bodies of the vertebrae are not distinct, they are less opaque than usual, the intervertebral discs thinner and the lateral projection of the bodies of the vertebrae shows slight thickening due to periosteal reaction. As the disease progresses the changes extend to more vertebrae, the periosteal reaction increases, the bodies of the vertebrae become more transparent and the outline more indistinct. The ones on which there is the most pressure become deformed. Osteoid processes form between the bodies of the vertebrae which finally unite and form a bony bridge. These bridges extend laterally and gradually form a cuff around the intervertebral disc. The intervertebral discs thin out until finally the bodies of the two adjacent vertebrae fuse with each



other. The vertebrae that are the most affected show the greatest decalcification. Later they become more opaque, the bone structure can no longer be recognized and they become eburnated and disc-shaped. There may be transparent areas with true sequestra alternating with areas of increased density.

From a discussion of the details of the pictures in his cases the author finds that there are three types of the disease: in the first type the bodies of the vertebrae and the intervertebral discs are affected and the organism reacts producing a sustaining cuff which helps to immobilize the column. In the second type there are multiple accessory formations along the affected segment of the cord. The third type is purely destructive with little or no reaction on the part of the organism.—*Audrey G. Morgan.*

MIRTO, DOMENICO. Rapporti fra rachischisi ed impotenza funzionale virile. (Relation between spina bifida and male impotence.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 112-115.

Piccinino was the first to find spina bifida occulta on roentgen examination in a surprisingly large number of patients with enuresis and he thinks spina bifida is the cause of the form of male impotence manifested by incomplete and precocious ejaculation. He reports that in 21 cases of this form of impotence there was spina bifida in all, generally of the 1st sacral vertebra, in a few cases of the 5th lumbar or even the 4th or 3d. And he also claims that in all cases of functional impotence examined there was spina bifida.

The author therefore examined a series of cases to see if these findings could be verified. He found that there can be functional male impotence without spina bifida and spina bifida without impotence, so the finding is by no means pathognomonic. Of course forms of functional impotence due to dyscrasia, the toxic forms and those due to general neurasthenia and psychoasthenia have nothing to do with spina bifida.—*Audrey G. Morgan.*

AIRALE. Osteoma della colonna vertebrale lombare e consecutiva idronefrosi per compressione dell'uretere. (Osteoma of the spinal column followed by hydronephrosis from compression of the ureter.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 123-124.

A young syphilitic after a trauma of the spinal column about two years ago, showed two

superimposed shadows on the right. One was very regularly circular; it reached from a little above the outline of the ilium to a peduncle which extended to the 2d and 3d lumbar vertebrae; above this there was another less intense one ovoid in form which extended beyond the first one both above and below. The first one was sharply circumscribed and was of the same density as the flat bones; inside it there was stratification and trabeculation like that of spongy bone; the second was uniform and less intense. It was a pedunculated osteoma of the 2d and 3d lumbar vertebrae. Such tumors are not rare in syphilitics but they are not usually as large as this one. The tumor had compressed the ureter and caused hydronephrosis and the kidney was greatly enlarged.—*Audrey G. Morgan.*

COLA. Sopra un caso di endotelioma della tibia. (A case of endothelioma of the tibia.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 124-125.

A woman, aged fifty-six, with a history of tuberculosis had for over a year complained of violent pain which came on suddenly in the upper third of the right leg. The leg was slightly red and swollen, hot to the touch and painful on pressure. The limb was not deformed and the joints were free. Roentgen examination of the epiphysis of the tibia showed a rounded transparent area the size of a chestnut, surrounded by a double opaque ring, with sclerosis of the surrounding bone and slight periosteal reaction. As diagnosis could not be made directly from the finding it had to be made by exclusion. The clinical diagnosis of osteomyelitis made by the surgeon was excluded by the roentgen characteristics of the focus and particularly the absence of any rarefying osteitis. The negative Wassermann reaction and the lack of any benefit from specific treatment excluded syphilis. The theory of mycosis, especially sporotrichosis, was excluded by the negative Widal-Abrami reaction and the lack of effect of an iodide treatment, which is specific in this disease. Operation showed a cavity with irregular walls containing a small amount of turbid liquid. Cultures of the liquid in agar and broth were sterile. Histological examination of fragments showed that it was an endothelioma and this diagnosis was confirmed by the numerous metastases that developed in the course of a year.—*Audrey G. Morgan.*

di un caso di osteosi  
monomelica (A case of eburn-  
ated osteosis of one limb.) *Arch. di radiol.*,  
Jan.-Feb., 1930, 6, 70-74.

A case described in a boy eleven years of age. He was sent to an institution for heliotherapy with a diagnosis of tuberculous coxitis. He began to have pain in the right leg in the latter part of 1926; it increased and he had spasms of pain that were so intense that he could not walk; there was limitation of movement of the right coxofemoral joint and the limb was in slight abduction. When he was examined in October, 1927, it was hard for him to walk; he limped and dragged his leg. There was no pain in the hip and no muscle atrophy. The movements of the coxofemoral joint were limited, especially abduction, which was painful. On roentgen examination the coxofemoral joint appeared to be intact; there was an ivory-like thickening of the internal part of the femur in the shape of a vertical stripe that was narrow above the lesser trochanter, widened a little toward the middle part of the diaphysis and then became narrower again. The Wassermann reaction was negative. Chronic osteomyelitis seemed to the author to be the most probable diagnosis as the lesion seemed to be limited to the diaphysis of the femur and was accompanied by marked functional disturbance. The patient was given heliotherapy in the summer of 1928, and improved so much that in January, 1929, he was sent back for roentgen examination again by his physician to prove that the diagnosis of tuberculous coxitis had really been the right one. The patient had some pain in the ankle; the functional disturbance of the hip was not cured but only improved so that he could walk with less difficulty. In addition to the previous stripe of eburnation roentgen examination showed a dense stripe on the proximal end of the tibia and on the upper third of the inner side and a spot of density on the astragalus. There is little doubt of the diagnosis of eburnated osteosis though the lesion was slight in extent. The author has not seen the patient since.

The case is interesting because of its course and its possible relation to the form of chronic osteomyelitis of unknown origin described by Sicard and Ragueneau; in their case the density was limited to one-half of one lumbar vertebra and the sacroiliac joint on that side. The fact

that in the author's case there was at first density only on the inner side of the femur and later other dense areas appeared in other parts of the limb suggests that it would have been interesting to follow up the case of Sicard and Ragueneau.—*Audrey G. Morgan.*

D'ISTRIA, ANTONIO. Un caso di discondroplasia. (A case of dyschondroplasia.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 116-122.

A man of forty-four was sent for roentgen examination of the thorax for suspected bronchial catarrh. His arms were unusually short; the tips of the fingers reached barely to the crests of the ilium. He said that ever since he was eight or ten years old his arms had been shorter than those of his brothers and sisters. There was no family history of such a malformation. The forearms were curved with the convexity inward and dorsally. Nothing unusual in the hands.

Roentgen examination of the humerus showed that the upper metaphysis was key-shaped with swelling of the inner border, while the outer one was normal except for some small exostoses. The bone at the level of the swelling showed some clear areas and some strips of increased density. The upper ends of the two ulnas seemed to be enlarged but normal in shape. The head of the left radius did not articulate with the condyle of the humerus, but on the external side there was a small projecting beak without any joint surface. The neck was abnormally long. On the right the head of the radius, which had a long neck, reached more than a centimeter above the joint line and the bicipital tuberosity was at the level where the head normally is. The condyle of the humerus at this joint was rudimentary; the head of the radius had no articulation with it. While at the proximal ends of the forearms there was a disturbance of growth of the radii, at the distal end the ulnas seemed to be most seriously affected. On the right the diaphysis of the ulna was concave forward and outward; at the union of the lower and middle thirds there was a small marginal exostosis; the lower end at the wrist was irregularly rounded; there was no trace of a styloid process and no epiphysis seemed to have been formed. The lower end of the ulna was about 1 cm. from the upper border of the pyramidal bone with which it should articulate. The diaphysis of the radius was S-shaped with the concavity backward in

the upper part and in the direction of the palm in the lower part. There were two small exostoses on the lower third running toward the palm. The lower epiphysis seemed to be abnormally elongated so that the joint surface was much more oblique inward than usual. On the left the lower end of the ulna was about 2 cm. from the upper margin of the pyramidal. A little above this there was a rounded tubercle that seemed to articulate with a corresponding excavation in the radius. It would seem that in the period of growth exostoses had developed at this level on the ulna and radius and that their form had become adapted to the necessities of pronation and supination, forming a true articulation. The radius was also thicker than that of the opposite side and its joint surface was more inclined inward. There were no abnormalities in the bones of the hands except some very small exostoses at the bases of the first phalanges of the ring and middle fingers on the left side. In the legs there were symmetrical exostoses on the inner borders of both tibias and vacuoles of various sizes surrounded by rings of increased density; there were almost symmetrical chondromata on the upper and lower epiphyses of both fibulas.

While the legs in this case showed the classical lesions of dyschondroplasia those in the arms were not like the ordinary picture. The key-shaped deformity of the inner border of the humeri was evidently the result of ossification of old enchondromata or else of simple excessive growth of bone. The deformities of the radius also seemed to be due to excessive growth, while those of the ulna were due to defective growth. This case is interesting because of its complexity and because it may help in defining the picture of dyschondroplasia more accurately.—*Audrey G. Morgan.*

LERICHE, R., and FONTAINE, R. Des ostéoporoses douloureuses post-traumatiques. (Painful post-traumatic osteoporoses.) *Presse méd.*, May 7, 1930, 38, 617-622.

The purpose of this article is to call attention to the surprising effect of sympathectomies on the osteoporoses resulting from certain injuries, as for example violent traumas without fracture, repeated traumas without the history of a clinical accident, obscure fractures (of the scaphoid, lower extremity of the radius, fibula, etc.) and finally certain operative procedures (removal of ingrown nail, astragalectomy, articular operations, etc.). As is known, the osteo-

porosis in all these instances is associated with severe clinical symptoms consisting in pain and limitation of function.

The authors have performed sympathectomy in 16 cases of the above group, with surprising results. Pain has disappeared within a few hours and the function has greatly improved or returned to normal within a few days following the operation. The roentgenograms of the bones revealed a rapid disappearance of the osteoporosis with return to normal within a few months.

The site of the sympathectomy was on the humeral artery in case of lesions of the wrist, on the subclavicular artery (prescalenic segment), or bicervico-scapular trunk in case of osteoporosis of the shoulder, on the superficial femoral artery in case of lesions of the ankle and on the external iliac (just above the crural arch) in case of osteoporosis of the knee.

The 16 cases are briefly described and illustrated with numerous pre- and postoperative roentgenograms and photographs showing remarkable functional improvement.—*T. Leucutia.*

BUNAMICI, C. BANGI. L'osteoperiostite ipertrofica pneumonica (Morbo di Marie). (Hypertrophic pulmonary osteoperiostitis (Marie's disease).) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 21-52.

The author describes a case in a man aged thirty-eight. In September, 1927, he began to notice that his hands were growing larger; the ends of the fingers enlarged and the nails became curved. The same changes took place in the feet. At the same time he began to have pains in his limbs, particularly when fatigued, chiefly in the knee and wrist joints and the malleoli. During the winter of 1926 he had had fever and pain in the right half of the thorax with a purulent fetid sputum. During the winter of 1928 he had cough and copious mucopurulent sputum. In July, 1928, he came to the hospital as the cough and copious sputum continued. On admission he had cough, no pain in the thorax. Percussion showed the lungs normal except for a small dull zone at the base of the right lung. Auscultation showed many large and medium-sized râles. The muscles of the limbs were slightly hypertrophied. Roentgen examination showed changes in the long bones. The bones of the skull and face were normal; the sella turcica was normal.



the long bones of the limbs and changes were enlarged; partly due to development of the spongy tissue but thinning of the cortex from production of the periosteum.

This patient had a history of syphilis but the author thinks this was a case of true Marie's disease which he calls pulmonary because it is generally seen in association, as in this case, with a chronic purulent disease of the pleura and lungs. It may be caused by other diseases however. There is also a nervous and constitutional factor in the disease. It is not hereditary but is secondary to toxic-infectious conditions. It should be differentiated from simple hippocratic fingers, which are seen in many diseases. In simple hippocratic fingers the changes are chiefly in the soft parts; the bones are not changed and there is no pain or functional impotence; its development is progressive and continuous. In Marie's disease there are changes in the bones and periosteum not only of the phalanges but also in other bones, with pain and functional weakness. The pain in the bones and joints is not continuous but in attacks. The diagnosis must be made by roentgen examination of the bones.—*Audrey G. Morgan.*

MATHEY-CORNAT. Étude radiographique de quelques cas d'ostéopathie déformante du type Paget. Tumeurs des os chez les Pagétiques. (Roentgen study of some cases of deforming osteopathy of the type of Paget; bone tumors in Paget's disease.) *Bull. et mém. Soc. de radiol. méd. de France*, March, 1930, 18, 159-162.

The author observed the occurrence of bone tumors in 2 cases of Paget's disease of long duration. In the first case, that of a man forty-four years of age (the Paget's disease lasting for fourteen years), an osteogenic sarcoma of the scapula developed, which terminated fatally within six months. In the second case, that of a man fifty-three years of age, the Paget's disease was associated with an osteochondroma of the ilium which was observed for a period of over four years. In this latter case the diagnosis was not confirmed by microscopic section.—*T. Leucutia.*

ZADEK, ISADORE. Complicated traumatic dislocation of the hip. *J. Bone & Joint Surg.*, April, 1930, 12, 419-428.

Zadek states that traumatic dislocation of the hip is a lesion of infrequent occurrence.

Its presence should be suspected when the hip is held fixed in a distorted attitude following a severe injury. Three cases of traumatic dislocation of the hip are reported. One was first seen by the author six weeks after the injury; the second, nine weeks after the injury and the third case on the day after the injury. The third case was complicated by a fracture of the shaft of the femur as well as a fracture of the head of the femur. The injury to the shaft of the bone completely overshadowed the hip lesion which had not been recognized.

It is possible to reduce these old dislocations weeks after their occurrence. One of the posterior variety was reduced by the closed method six weeks after the injury. Another (obturator) was reduced by open operation ten weeks after its occurrence. The ages of these patients were in the twentieth to the fortieth year limit, which as Baetjer has observed, is roughly the common age incidence. At an earlier and later period, fracture of the neck of the femur is most likely to occur.

Cases of this sort should be recognized early as the result of reduction of the old cases compares most unfavorably with the recent ones, particularly because of the subsequent occurrence of an osteoarthritis. One of Zadek's patients showed a leucocytosis and an increase in polymorphonuclear leucocytes from a considerable hemorrhage into the tissues. No other source or cause for this leucocytosis could be found.

The paper is illustrated with roentgenograms of the cases both before and after the operations for reduction, and also in one case eighteen months after the operation, which shows a marked osteoarthritis of the hip joint.—*R. S. Bromer.*

ROBERTS, PERCY W. An unusual congenital anomaly of the bones of the leg. *J. Bone & Joint Surg.*, April, 1930, 12, 414-415.

Roberts reports a case of a child of seven years of age, born with a moderate equinovarus. The affected extremity was  $2\frac{1}{2}$  inches shorter than the normal, and clinically it showed what appeared to be a lateral deflection of the lower end of the fibula, suggestive of an old fracture. The roentgen examination showed a most unusual condition. The fibula, beginning at the junction of the lower and middle thirds, was flared out, not unlike a normal tibia, and the lower half of the tibia was tapered without any evidence of a malleolar expansion.

The ankle joint was formed by the articulation of the lower end of the fibula with a misshapen astragalus. Roentgenograms made at the age of seven months showed the malformations in their early stages.

While the shortening could in some degree be accounted for by a fracture of the fibula which occurred during a manipulation of the foot, made at an early age to correct the equinovarus, there is no doubt that it is chiefly due to congenital disturbance in the centers of growth as indicated in the roentgenograms made in the first few months of life. This observation is of interest in venturing a prognosis in similar cases.—*R. S. Bromer.*

BÖHM, MAX. The development of juvenile pes valgus. *J. Bone & Joint Surg.*, April, 1930, 12, 333-344.

This article is based on material presented by the author at the Congress of the German Orthopedic Society. In his orthopedic clinic a great number of "valgus deformities" of the foot are classed under the generic name "flat foot." Hoffa attempted to clear up this rather confusing classification. He differentiated clearly between true flat foot in which the arch is flattened out, and the pes valgus which appeared to be an outward twist of the medial malleolus. This may persist or it may go on to the formation of a true flat foot by the secondary depression of the arch. The pes valgus as described by Hoffa appears at puberty as a "static" pes valgus, and he thought that continual weight-bearing on the feet was responsible for the deformity.

Böhm believes that cases which one might term secondary should be separated from pes valgus. These are the result of trauma, such as fractures, or bone disease and joint affections, paralysis, etc. In addition to this group is a second, the rachitic. Rickets sometimes produces an outward bending of the leg resulting in a varus deformity. A third group is the purely compensatory pes valgus which develops in connection with varus deformities of the lower extremities due to various causes.

If these three groups are separated the true idiopathic pes valgus remains. This is more noticeable at puberty than at any other time. Böhm analyzes the clinical picture in detail and feels that an assumption that a developmental anomaly is the important factor in the etiology of the condition is justified. He then reviews the normal development of the ankle

joint, and reports the results of his cases. In many patients he found that the medial malleolus was more prominent than it should be at the age of puberty. The tibial joint surface as defined in the roentgenogram runs obliquely from the medial below to the lateral above, the epiphysis, therefore, being considerably decreased in size toward the lateral side. The roentgen study thus discloses an anatomic condition similar to that which he demonstrates in the embryonic and infantile foot. This analogy suggests the conclusion that idiopathic pes valgus is the clinical manifestation of a developmental arrest. This conclusion is supported by the fact that the deformity shows a very definite hereditary and familial selectivity.

To rule out the possibility that the wedge-shaped distal tibial epiphysis might be a secondary condition, a mechanical deformity resulting from abduction of the foot caused by other factors, Böhm made a roentgen study of such cases and found that the typical wedging of the distal epiphysis of the tibia was lacking.

As a result of his studies he feels that pes valgus idiopathicus is the result of a faulty development. With this abnormal condition, the plastic material of the growing bones of the foot is defective and static forces during development can progressively exaggerate the deformity.—*R. S. Bromer.*

AUBERTIN, CH., THOYER-ROZAT., and LÉVY, ROBERT. La radiothérapie de la maladie de Hodgkin (lymphogranulomatose maligne). (Radiotherapy of Hodgkin's disease (malignant lymphogranulomatosis).) *J. de radiol. et d'électrol.*, March, 1930, 14, 145-157.

After a detailed description of the symptomatology, evolution, clinical forms, and diagnostic procedures of Hodgkin's disease, the authors discuss the various radiotherapeutic procedures such as roentgen therapy, curie therapy, and the subcutaneous injection of thorium X.

The article constitutes a summary of the present methods of radiation therapy in Hodgkin's disease.—*T. Leucutia.*

GAUDUCHEAU, R., BRILLOUET and LÉVESQUE. Trois cas de sarcomes lymphoblastiques de l'amygdale et de la région carotidienne inférieure. (Three cases of lymphoblastic sarcoma of the tonsil and inferior carotid region.) *J. de radiol. et d'électrol.*, March, 1930, 14, 177-181.

...the authors published 5 cases of lymphoblastic sarcoma of the nasopharynx of which 3 have died and 2 have remained well (following deep roentgen therapy) for a period of 4½ and 2½ years respectively. In the present article 3 new cases are added, one of which was cured by deep roentgen therapy. The 3 cases are described in detail. The conclusion is reached that in lymphocytoma or lymphoblastic sarcoma roentgen therapy with penetrating rays is the method of choice and that surgical interventions are not only useless but directly contraindicated. In case of biopsy it is wise to administer preliminary irradiation over the gland or tumor to be removed.—*T. Leucutia.*

GARGIULO, MARIO. Trattamento Rontgen di pterigio recidivante degenerato. (Roentgen treatment of degenerative recurrent pterygium.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 250-252.

A patient blind in the right eye from juvenile trauma was operated on in 1915 for internal progressive recurrent pterygium of the periphery of the pupillary disc of the cornea. It recurred and he was operated on again in 1923; he came back in 1928 for great decrease of vision. Examination showed that more than half the internal part of the cornea had lost its transparency and normal structure and was replaced by a grayish-white tissue; there was a distinct line of demarcation between the opaque and the transparent part. The grayish-white tissue extended a little distance onto the internal bulbar conjunctiva. The diagnosis was degenerative pannus of the cornea of the type described by Baas. The infiltration in this case was made up of round cells and blood vessels and was situated between the epithelium and Bowman's membrane.

The patient was advised to take roentgen treatment before trying operation. The object was to stimulate the defensive powers of the organism against the young new-formed tissue. He was irradiated using a focus skin distance of 23 cm., a spark gap of 35 cm., 2 ma., filter 0.5 mm. zinc and 3 mm. aluminum, ¼ skin erythema dose. This was repeated four times at intervals of 20 days. The opaque tissue covering the cornea disappeared and vision improved. There were no signs of irritation during the treatment. The patient has been under observation a month since the treatment and

there has been no aggravation.—*Audrey G. Morgan.*

PRICININO, G. Sul meccanismo di azione della roentgenterapia nella paralisi infantile. (Mechanism of action of roentgen therapy in infantile paralysis.) *Arch. di radiol.*, Jan.-Feb., 1930, 6, 243-245.

A case is described in a child twelve months of age who two months before had quite a serious case of poliomyelitis resulting in complete flaccid paralysis of the upper and lower limbs. The treatment was begun by giving two-thirds of an erythema dose at a distance of 30 cm. over the lumbar region, in the course of six days. The patient was to be brought back in two weeks for irradiation of the cervical region but did not return for two months. There was marked improvement limited to the lower limbs. Electrical examination showed partial reaction of degeneration in some muscle groups while normal electrical reaction was restored in some. The same dose was then given over the cervical region; when the patient was brought back after two months there was great improvement in the movement of the arms, particularly the right one. There was still partial reaction of degeneration in some muscle groups.

This shows the value of roentgen treatment in infantile paralysis. This cannot have been a case of spontaneous regression as each time the improvement was only in the region treated. The treatment is more successful the earlier it is given in the paralysis and is not successful at all if not given until after there is complete degeneration of the nerve cells.—*Audrey G. Morgan.*

WESTERMARK, NILS. The result of the combined surgical and radiological treatment of cancer mammae at Radiumhemmet 1921-1923. *Acta radiol.*, Apr. 30, 1930, 11, 1-32.

This article covers all the cases of cancer of the breast, 307 in all, that applied for treatment at the Radium Institute for the years 1921-1923. Of these 52 cases were not treated; 162 cases have been given combined surgical and radiological treatment. Of these 162 cases 75 have had postoperative radiological treatment, 45 have had radiological treatment before as well as after the operation and in 42 cases the radiological treatment has been combined with removal of the tumor by electroendothermy. Twenty-two cases of primary



cases showe  
asis on admission an have  
d radiologically. All the cases but  
n examined several times a year until  
th, or in the cases in which the patients  
d alive, until the end of 1928.

give an idea of the value of the radiolog-  
reatment the author compares the results  
obtained at the Radium Institute with those  
obtained by surgical treatment of cancer of  
the breast in Sweden. The results of this com-  
parison of cases treated only surgically and  
those given combined surgical and radiotherapy  
are as follows: There was five-year freedom  
from symptoms in a relatively larger number  
of the cases given combined surgical and radio-  
logical treatment. The surgical statistics in  
Sweden show a five-year freedom from symp-  
toms in 16.8 to 25.5 per cent of the cases.  
The cases given radiotherapy after operation  
show a corresponding freedom from symptoms  
in 29.3 per cent, those treated preoperatively  
in 40 per cent. The cases treated by endo-  
thermia, which in this series were much more  
serious in nature, showed freedom from symp-  
toms in 28.6 per cent. The recurrences and  
metastases given radiotherapy showed freedom  
from symptoms in 9.8 per cent of the cases  
after more than five years.

The interval before any signs of local recur-  
rence appear after the combined treatment is  
about the same as after surgical treatment.  
But there is a much longer interval before dis-  
tant metastases become manifest in cases  
treated with radiation and surgery than in  
those treated with surgery alone. The local  
recurrences occur much less frequently after  
the combined treatment than after surgical  
treatment alone. After surgical treatment 55.7  
per cent of the recurrences are local in nature.  
The postoperative group shows 48 per cent  
local recurrences, the preoperative group 29.2  
per cent and the endothermic group 12.5 per  
cent.

The duration of life after the appearance of  
the first symptom and after the commence-  
ment of treatment is in case of patients who  
die of cancer, much longer after the combined  
therapy than after surgical treatment. Patients  
only operated on have lived on an average  
thirty-nine months after the appearance of  
the first symptom and twenty-three months  
after the first treatment, the cases treated  
postoperatively forty-nine and thirty-one

vely, the pr  
d forty-one m.  
ases sixty-seven  
months-respectively. Patie  
the breast who are not treat  
of thirty-one months after the app  
the first symptom.—Audrey G. Morgan.

KOLTA, ERWIN, and DUNAY, BEATRIX. Die  
neuere Strahlenbehandlung der Magenge-  
schwüre. (The newer radiation therapy of  
gastric ulcers.) *Klin. Wchnschr.*, June 11,  
1929, 8, 1125-1127.

Ten cases of gastric ulcers were treated by  
irradiating regions distant from the stomach,  
especially the anterior and posterior aspects of  
both thighs (field 15×15 cm.,  $\frac{3}{4}$  s.u.d., with  
3 mm. Al, in 4 consecutive days, the series  
being repeated at intervals of 4, 8 and 12  
weeks). The acid-alkaline balance of the blood  
and urine was determined previous and sub-  
sequent to every irradiation. It was found that  
a shifting towards the alkaline side of the reac-  
tion of the blood resulted after every exposure,  
later leading to permanent reestablishment of  
the normal balance. Of the 10 patients treated,  
in 6 there was complete healing both as re-  
gards the reestablishment of the normal acid-  
alkaline balance and the roentgen visualization  
of the ulcer, in 3 there was subjective improve-  
ment but the niches failed to disappear and in  
one there was deterioration. Five of the cases  
are briefly described and their laboratory data  
presented. It is interesting to observe that all  
patients kept their usual diet and were able  
to go about their occupations during the period  
of the treatment.

The conclusion is reached that irradiation  
of distant parts of the body may lead to a  
healing of gastric ulcers through a shifting of  
the acid-alkaline balance of the blood towards  
the alkaline side.—T. Leucutia.

BAGDASAROFF, A., and KOPELMANN, S. Zur  
Röntgenbehandlung der Magenerkrankun-  
gen. (The roentgen treatment of gastric  
affections.) *Fortschr. a. d. Geb. d. Röntgen-  
strahlen*, March, 1930, 41, 434-442.

Nineteen cases of gastric conditions were  
treated by roentgen rays, 11 of which were  
gastric and duodenal ulcers, 5 simple gastritis  
with moderate or severe hyperacidity and 3  
achylia and gastritis with anacidity.

The technique used was as follows: Neo-  
apparatus, Coolidge tube, 18 kv.,

(The influence of roentgen rays on healing of fractures.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, April, 1930, 41, 581-588.

The author investigated the effect of roentgen rays on callus production by irradiating fractured fibulae (in their upper thirds) of rabbits. Eighty-four animals were used for the purpose of experimentation, and the irradiation was carried out with the following technique: 170 kv., 30 cm. distance., 0.5 mm. Zn filter, a 14 min. exposure corresponding to 8 H (400 R) or 75 per cent S.U.D. In one series the irradiation was carried out with fractional doses, 8 H being given on four consecutive days (total 32 H). In a second series one single dose of 8 H (400 R) was given, while in a third series the dose was reduced to half. The control examinations were carried out by means of roentgenograms, macroscopic inspection of the fractured bones and by means of microscopic sections.

It was found that an increased quantity of callus does not necessarily imply a callus of good quality, in fact, the two are often antagonistic; a large amount of callus may result in delayed healing, while a small amount of callus but of good quality, may hasten the healing.

The effect of the various doses was as follows: (1) Large roentgen doses produced first an entire lack (lasting for a period of two weeks), and thereafter an increased amount of callus formation, the healing as a whole being delayed. (2) The moderate doses led to a decrease in the quantity but to increase in the quality of callus, as a whole accelerating the healing. (3) In small doses there was no noticeable effect.—*T. Leucutia*.

TABERN, D. L., HANSEN, N. A., VOLWILER, E. H., and CRANDALL, L. A. A study of the

cathode-ray impact, employed in roentgenology. consisting of 1930, 14, 364-371. metal

For several years iodized oils have been employed to great advantage for the roentgenographic and roentgenoscopic visualization of certain body cavities. The iodized oils, however, are unstable toward heat, light and moisture; the iodine or iodides subsequently always liberated in the body may, over long periods of time, cause toxemia, irritation, or iodism; their cost is considerable, and their viscosity is so high that they are frequently ill suited for the particular purpose. Accordingly, the authors have undertaken the development and study of brominized oils and esters as substitutes for the iodine mixtures. Two products have been found to possess the most desirable properties. The first was 33 per cent brominized olive oil esters (viscosity 7 sec.) and the second a mixture of 85 per cent brominized olive oil and 15 per cent of brominized olive esters (viscosity 120 sec.). For filling nasal accessory sinuses the brominized olive esters are preferable; filling is rapid and complete and the time of drainage is reduced by many hours. The ester product is also superior for visualization of the seminal vesicles and has been used successfully for pyelography. It was introduced into the uterus and fallopian tubes and little pressure was necessary, but the tubal shadows were less distinct than with oils of higher viscosity. For visualization of the bronchial system, the second mixture is preferable. The brominized oils and esters are more stable than the iodized oils, have controllable viscosities without loss of radiopacity, are economical to manufacture and use, low in toxicity, and, of course, cannot cause iodism.—*J. D. Camp*.



In

cm., 30 cm.

Al, 1 S.U.D. (2) given alternately over at two to four days' intervals. It consisted of three sances and was repeated in the majority of the cases repeated within three to five weeks.

The cases with gastric and duodenal ulcers responded favorably to radiation both as regards the subjective and objective symptoms. Only 2 cases with very marked adhesions remained uninfluenced. There was also improvement in the cases of simple gastritis with hyperacidity but all cases of achylia and of gastritis with anacidity remained recalcitrant to the treatment.

The authors investigated the changes in the acid-alkaline balance of the blood and in the reaction of the sympathetic system during the course of the treatment and they found that there was a parallelism between the shifting of the acid-alkaline balance of the blood towards the alkaline side and of the tonus of the vegetative system towards amphotonia (while previously there was vagotonia). This in their estimation indicates that the effect of the roentgen rays is chiefly through the sympathetic system.—*T. Leucutia.*

STUHL, L. Guérison par la radiothérapie de deux cas d'actinomycose cervicofaciale. (Healing with roentgen therapy of two cases of cervico-facial actinomycosis.) *Bull. et mém. Soc. de radiol. méd. de France*, May, 1930, 18, 210-214.

The author successfully treated 2 cases of actinomycosis of the neck and face with the combined method of iodine and roentgen therapy. The iodine was administered in the form of Lugol's solution in doses of one tablespoonful three times a day, while the roentgen therapy was carried out with weekly doses of 250 R (25 cm. spark gap, 6/10 mm. Al filter, 30 cm. skin target distance), for a total of from 1500 to 2500 R. A complete healing resulted. The opinion is expressed that the roentgen-iodine treatment is the method of choice.—*T. Leucutia.*

DESPLATS and LANGERON. L'irradiation des régions surrénales dans la vasoconstriction et dans la vasodilatation des extrémités. (Irradiation of the suprarenal regions in vasoconstriction and vasodilatation.)

France, Jan. 3, 1930

The authors report additional results of the treatment of claudication treated by irradiation of the renal region with satisfactory results. The conclusion is reached (1) that roentgen therapy of the suprarenal region produces an immediate relief of pain, with disappearance of the temperature changes, and a reestablishment of normal vascular reflexes in arteritis obliterans and the vasoconstriction syndrome; (2) that roentgen therapy likewise produces a relief of pain in the syndrome of vasodilatation, and (3) that the mechanism of this action, difficult to explain, is most probably through reestablishment of the equilibrium of vasomotor regulation.—*T. Leucutia.*

LABORDE, SIMONE. Résumé des travaux de la sous-commission chargée de l'étude de la radiothérapie du cancer du col de l'utérus. (Résumé of the work of the subcommittee charged with the study of radiotherapy of cancer of the uterine cervix.) *J. de radiol. et d'électrol.*, Feb., 1930, 14, 96-100.

The cancer committee of the League of Nations has created a subcommittee for the study of the radiotherapeutic procedures in cancer of the uterus. Among the members of the subcommittee, Heyman, Lacassagne and Voltz have published individually the technique and results in the radiotherapy of cervical uterine cancers (Radiumhemmet of Stockholm, Curie Foundation of Paris and Universitäts Frauenklinik of Munich).

Regaud, the president of the subcommittee, has summarized the work of the organization in a detailed report. The salient points of this report are briefly reviewed in this article. They comprise: (1) the classification of the various forms of utero-cervical epitheliomas; (2) the division of the epitheliomas of the cervix into different stages according to their anatomical extension; (3) establishment of certain standards for the publication of therapeutic results, and (4) the general principles of the therapeutic procedures.

The classification of the epitheliomas of the cervix into four stages according to the anatomical extension is discussed and the results obtained at the above three institutions are given.—*T. Leucutia.*

FUKASE, SHUICHI. Über die Beeinflussung der Frakturheilung durch Röntgenstrahlen.



# AN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. XXIV

DECEMBER, 1930

No. 6

## THE DEVELOPMENT OF MODERN ROENTGEN-RAY GENERATING APPARATUS

CALDWELL LECTURE 1930\*

By W. D. COOLIDGE, PH.D.

SCHENECTADY, NEW YORK

### 1. INTRODUCTION

### 2. THE X-RAY TUBE

- a. Its Early Development.
- b. Development of Ductile Tungsten.
- c. The Tungsten Target.
- d. Historical Development of the Hot-cathode Tube.
- e. Heat Removal from Focal Spot.
- f. Focal Spot Shape and Size.
- g. Tubes for very High Voltage Roentgen Therapy.

### 3. THE HIGH VOLTAGE GENERATING APPARATUS

- a. Early Development.
- b. The Self-rectifying X-ray Tube.
- c. The Kenotron Machine.
- d. The Induction Coil for very High Voltage.

### 4. PROTECTION FROM ELECTRIC SHOCK, AND THE OIL-IMMERSED TYPE OF EQUIPMENT.

### 5. PRECISION TIMING IN FAST ROENTGENOGRAPHY.

#### I. INTRODUCTION

THE memory of Eugene Wilson Caldwell will always serve as an inspiration to those who knew him. It was one of the great privileges of my life to be included in his circle of friends. To think of him always brings to my mind those sterling traits of character which he possessed to such an unusual degree. I think of his indefatigable zeal, his dissatisfaction with his own achievement and his constant striving to better it, his great courage and patience in the face of difficulties and, finally, his unconquerable spirit which re-

fused to yield to the sufferings his early roentgen work had brought upon him.

I feel unworthy to give this Caldwell Lecture, but greatly honored in being asked to do so, for I am mindful not only of the great Caldwell, but also of those distinguished men who have preceded me in the series.

The subject of my lecture this evening is the outgrowth of a suggestion made by Dr. Moore that I talk on the historical development of the hot-cathode tube. I questioned at first whether I could make so old a subject interesting to you, but then I remembered that while the theme

\* Delivered at the Thirty-first Annual Meeting, American Roentgen Ray Society, West Baden, Indiana, Sept. 23-26, 1930.

would be old to some it would be new to others. And then I thought that by broadening the field to include the balance of the x-ray generating outfit, I could add more fresh material.

I will limit myself to the medical field, but will make no attempt to cover the whole of it.

## 2. THE X-RAY TUBE

### a. Its Early Development.

The early x-ray tube of Roentgen (Fig. 1), the Crookes tube, was greatly improved

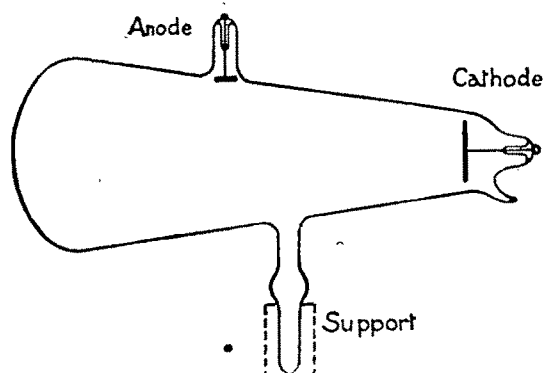


FIG. 1. Early type of x-ray tube used by Roentgen.

by Campbell-Swinton through the introduction of a platinum target and by Jackson, who turned to account a former discovery of Crookes and used a concave cathode (Fig. 2).

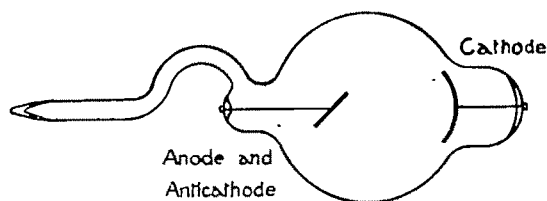


FIG. 2. Jackson's first tube employing focussed cathode rays.

A later step of great importance was the addition of a device for regulating the vacuum of the tube.

For medical diagnostic work, the thin metal target was soon replaced by a heavy mass of metal consisting essentially of two parts, a refractory metal face to take the

and a... of some good... which would serve away and temporarily store... erated at the focal spot.

Platinum and copper came into very general use for the refractory metal face and backplate, respectively. The platinum facing was made very thin, about 1/1000 inch thick, and was attached to a disk of nickel which, in turn, was soldered to the large mass of copper. The tube had a very definite energy limitation and, if this were exceeded even for an instant, the thin facing of platinum was ruined at the focal spot and the tube had outlived its usefulness.

### b. Development of Ductile Tungsten.

In 1905 some developmental incandescent lamp work was started in our laboratory, which led us later into the x-ray tube field. This work began with an investigation of the mechanical properties of metallic tungsten, and resulted first in the production of this element in a ductile form, and finally in its application for various purposes—among others its use for both electrodes of the x-ray tube.

Up to the time when this work was begun, tungsten had always been a brittle metal—as brittle as glass—and not workable. As a result of laboratory efforts extending over several years and involving many men, it became possible to produce metallic tungsten in a form in which it has the strength of steel.

The process which we developed for producing ductile tungsten is unique in this respect, among others, that it does not involve the melting of the metal in a crucible. This has never been feasible, for the reason that there is no suitable material from which the crucible can be made. The fireclays which have been used for crucibles all vaporize at temperatures far below the melting temperature of tungsten.

The process starts with wolframite (an ore consisting of iron, manganese, tungsten, and oxygen) from which the yellow oxide

THE



FIG. 3. Battery of electric, hydrogen-atmosphere furnaces for reducing the yellow oxide of tungsten to metallic powder.

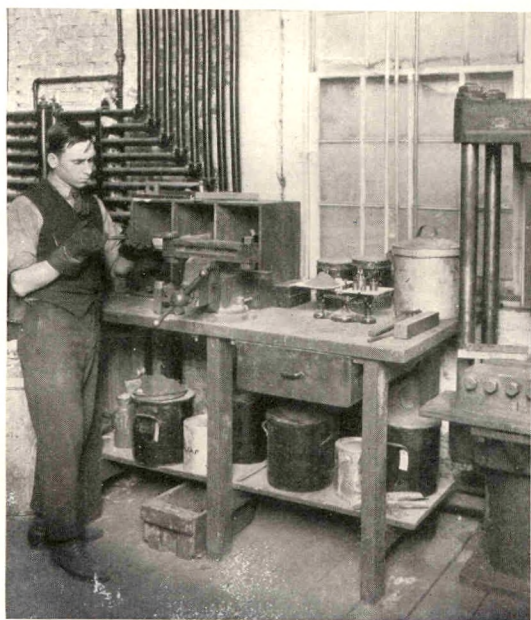


FIG. 4. Compressing the metallic tungsten powder to rod form by means of hydraulic press and steel mold.

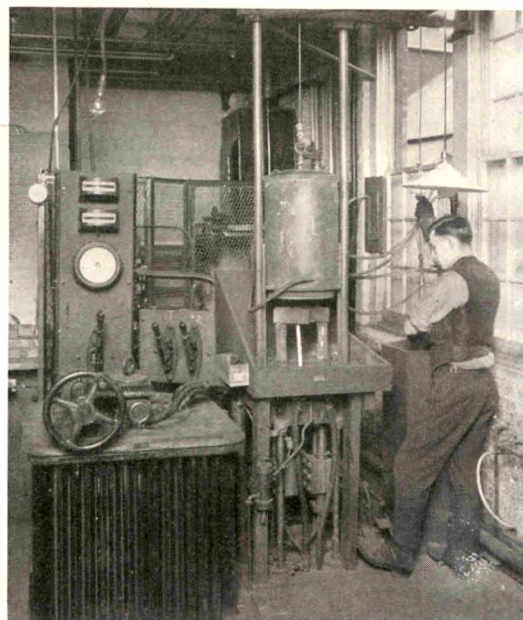


FIG. 5. Sintering tungsten rod in hydrogen treating bottle (raised to show rod clamped in position).



of tungsten is extracted and highly purified.

This yellow oxide is next reduced to metal powder by heating it electrically in a porcelain tube through which a stream of hydrogen gas is passing (Fig. 3). A very careful and exact control of the conditions of the reduction process is necessary, so that the resulting tungsten particles shall have the right size.

The dry tungsten powder is next formed under heavy pressure into rods (Fig. 4), and these are then heated electrically almost to the melting point in hydrogen (Fig. 5). The resulting ingots are brittle cold, but can, with care, be mechanically worked when hot (Fig. 6), and as the mechanical



FIG. 6. Hot swaging the tungsten rod.

working proceeds the individual crystals are elongated into fibers (Fig. 7) and the metal is thereby strengthened. With sufficient working the resulting material becomes ductile cold.

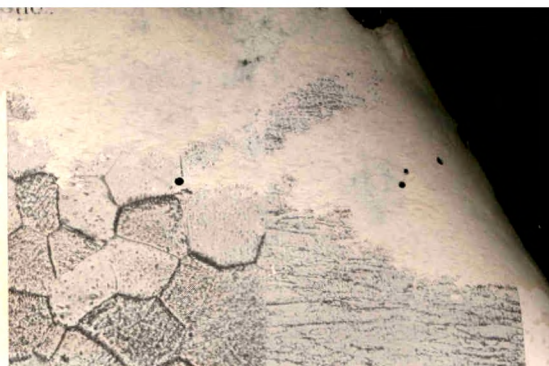


FIG. 7. Photomicrograph of the crystalline structure of tungsten before swaging (left) and the fibrous structure afterward (right).

### *c. The Tungsten Target.*

After the ductile tungsten process had been developed sufficiently for the needs of incandescent lamp manufacture, the next application which we found for it was as the target of the gas-filled x-ray tube, in place of the platinum which had previously been used.

For this application, sheet tungsten was required, and it was found that this could be produced by hot-rolling the original rods or, better, those which had first had a certain amount of hot hammering. From such sheets or strips the small disks required were produced by hot-punching (Fig. 8).

Our next problem—and it caused a delay of many months—was to find a method for bringing a disk of tungsten into good heat-conducting relation with the large block of copper forming the balance of the target. There was, at that time, no known means for soldering tungsten to copper or to anything else.

It finally developed that copper could be attached directly to tungsten in the following manner: The surface of the tungsten is first carefully freed from oxide. Copper which has been freed of its oxide by treatment with one of the boron compounds is then cast in a vacuum onto the tungsten. Under these conditions, the copper wets the surface of the tungsten as water wets glass, and the result is a union of very high thermal conductivity



the two  
desired for  
ion are  
ion are  
the crucible, 1, is  
inside diameter slightly  
the desired diameter of the  
target. A removable graphite  
piece, 2, is made to stand in the bottom  
of the crucible and to serve as a temporary  
support, at the desired angle, for the tung-  
sten disk, 5. The latter is kept from sliding  
down the inclined face of its support by  
two little molybdenum pins, 6 and 7, which  
fit in holes in the graphite support. A  
block of boron-treated copper, 8, is then  
placed in the crucible. The crucible and its  
contents are then placed, together with

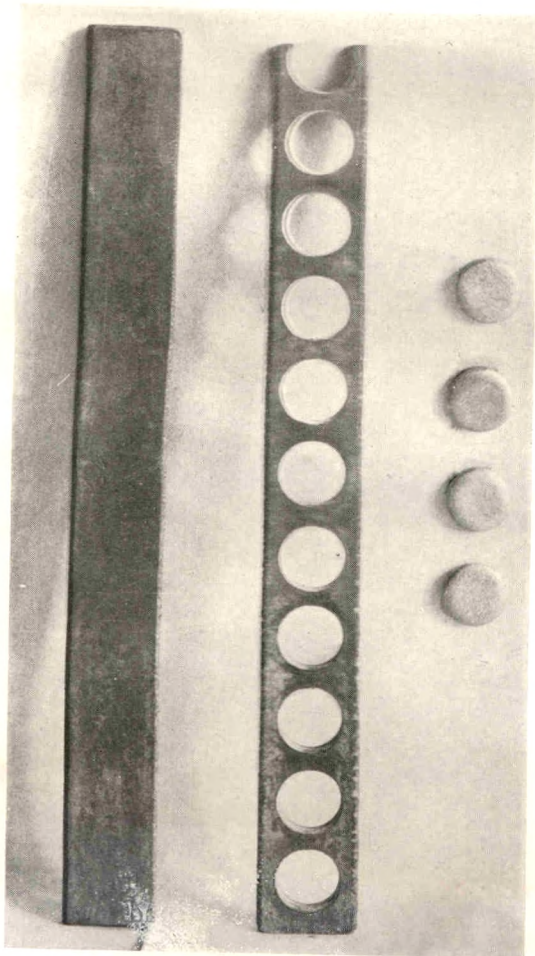
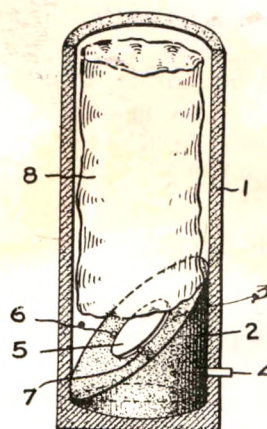


FIG. 8. Steps in the production of the tungsten disks for x-ray targets.

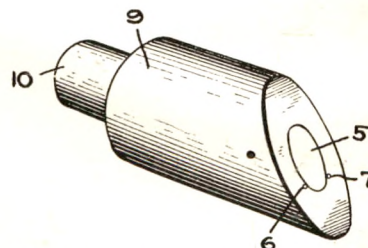


FIG. 9. Means for vacuum-casting of copper around tungsten disk, and the finished copper-backed tungsten target.

others, in an electrically heated vacuum furnace and the temperature is raised slightly above the melting point of the copper. The temperature must not be too high, as otherwise the strength which has been produced in the tungsten by the mechanical working will be lost and the target will crack badly in use.

The tungsten disk must not be too thin, for otherwise copper will melt back of the focal spot and will, by its expansion, cause a bulging out of the tungsten at this point. Upon cooling, the copper will contract, leaving a vacuous space immediately under the tungsten at the focal spot; the target is then ruined, as the good heat conductivity between the tungsten and the copper at the focal spot has been lost. As copper conducts heat better than tungsten, it is,



on the other hand, better to have the tungsten disk no thicker than is necessary to avoid the melting of the copper under the focal spot.

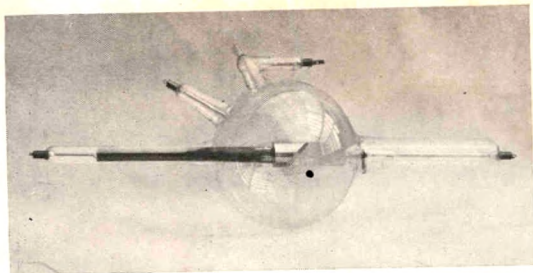


FIG. 10. Gas tube employing copper-backed tungsten target.

The advantages of ductile tungsten over platinum for the target face are its higher melting point, lower vapor pressure, and greater heat conductivity. Its use resulted in better definition in diagnostic work because it made possible the production of much higher x-ray intensities from a given size of focal spot.

Trial targets consisting entirely of tungsten were also made for the gas tube, and, in competition with those of solid platinum, they also looked very attractive as they were capable of radiating from a given surface area, much greater amounts of energy.

Before the advent of the hot-cathode tube, the tungsten target (Fig. 10) had replaced the platinum target almost completely in the high power roentgenographic tubes made in this country.

#### *d. Historical Development of the Hot-Cathode Tube.*

The development work on the copper-backed tungsten target brought with it interesting experiences with gas-filled x-ray tubes that had been built to enable us to test out different constructions and designs of target. Large amounts of energy were passed through these tubes to show which kind of target best withstood abuse. Upon overloading the focal spot, tungsten vapor was produced and this tungsten vapor

caused about very rapid change of pressure. These pressure changes were easily explainable. Dr. Langmuir found that tungsten vapor united readily with nitrogen; hence nitrogen gas was removed as such and deposited as solid nitride on the walls of the tube. Oxygen reacted with hot tungsten to form a solid oxide of tungsten which was also deposited on the bulb. Hydrogen, argon and helium were tried but it was found that, in time, they also disappear from the space. These gases which do not react with hot tungsten or with tungsten vapor are probably, in part, shot into the glass and, in part, trapped under the tungsten which deposits rapidly on the surface of the bulb when the tube is overloaded.

Upon overloading the tubes, the glass around the cathode became very hot and frequently cracked. This was finally prevented by immersing the tubes completely in oil.

Another trouble then made its appearance. The aluminum cathodes melted. To obviate this, a solid tungsten cathode was tried. This made the tube exceedingly "cranky." One would no sooner get it started than it would refuse to carry current until more gas had been introduced from the regulator.

The extreme instability attendant upon the use of a cold tungsten cathode in what was otherwise a standard x-ray tube, called attention forcibly to the part played by the gas in the ordinary aluminum cathode. (The tungsten cathodes were relatively very free from gas.)

The need of gas in the aluminum cathode had been well recognized, and, as far back as Dec. 6, 1899, we find a note by Rollins referring to a tube having an aluminum cathode which had been intentionally deprived of its usual hydrogen gas content. He says, "Such a tube could rest until doomsday and not make the faintest spark in the universal gloom."

In considering the various troubles ex-

<sup>1</sup> *J. Am. Chem. Soc.*, 1911, 35, 943.



tion of these tubes, namely, that they all in the tube and the on bombardment that took place in gas was present. It was clearly desirable to get rid of the gas, but it was then imperative to have some other mechanism for getting electrons out of the cathode.

Edison, in his work on the incandescent lamp, had shown that in the vacuum of the lamp, current could be made to flow from the hot filament to an anode. Much additional light had been shed on this phenomenon by the work of Richardson<sup>2</sup> and others. Richardson had investigated the law connecting the electron emission with the temperature of the hot body. The values of the currents obtained from hot cathodes by different observers had varied between such wide limits, however, as to suggest that an x-ray tube based upon this principle might be as unstable as the regular gas tube. Furthermore, some investigators had come to the belief that the whole hot cathode effect was due to gas contained in the cathode itself and that no current would flow from a hot cathode which had been completely freed from gas.

This was the state of affairs when Langmuir,<sup>3</sup> in our laboratory, took up the study of the electron emission from hot tungsten filaments. He found that the electron emission not only persisted in high vacua, but was favored by getting rid of the last traces of the tube. In this way, he was able to realize conditions which were stable and reproducible.

The same method was tried with the x-ray tube, and we found that here also, even with the much higher voltages and the much larger masses of metal, we were able to get and to maintain vacua in which the phenomena were stable and reproducible.<sup>4</sup>

The idea of using a hot cathode in an x-ray tube was not new, but the principle

had never been successfully applied in a vacuum so good that positive ions did not play either an essential or a harmful role.

The hot-cathode tube of Wehnelt and Trenkle<sup>5</sup> employed a lime-coated hot-cath-

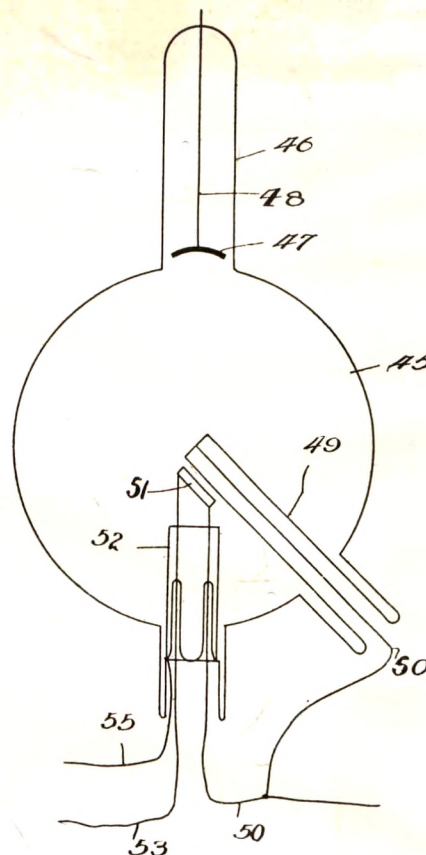


FIG. 11. Early type of Lilienfeld x-ray tube.

ode as a main electrode, but the vacuum employed was too poor to permit of operation with more than about 1000 volts, as otherwise the positive ion bombardment removed the electron-emitting lime coating from the cathode.

In the early hot-cathode tube of Lilienfeld<sup>6</sup> (Fig. 11) the main electrodes, 47 and 49, were exactly the same as in the ordinary gas tube. By means of current flowing between a pair of auxiliary electrodes, 51 and 52, the cathode of which, 51, was heated, the gas content of the tube was

<sup>2</sup> *Proc. Camb. Phil. Soc.*, 1902, 11, 286.

<sup>3</sup> *Proc. Roy. Soc.*, 1903, 71, 415-418.

<sup>4</sup> *Phys. Rev.*, 1913, 2, 409-430.

<sup>5</sup> *Sitzungsber. d. phys.-med. Soc. zu Erlangen*, 1905, 37, 312-315.

<sup>6</sup> Lilienfeld, J. E., and W. J. Rosenthal, W. J. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1912, 18, 256-263.



ion at, and, by varying the discharge current passing between the auxiliary electrodes, the conductivity of the tube could be controlled. The tube operated with a somewhat lower gas pressure than that of the ordinary gas tube. It was still a gas tube, however, and could not be operated if the pressure became too low.

In the first of our tubes, the cathode consisted of a spiral tungsten filament mounted behind a centrally perforated tungsten or molybdenum focussing disk, both filament and disk being set in the cathode side-arm and the anode consisted of a circular tungsten disk attached to the end of a tungsten support-rod (Fig. 12).

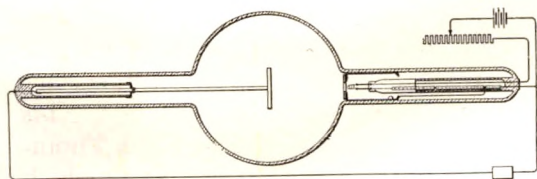


FIG. 12. Diagram of early type of hot-cathode x-ray tube with spiral tungsten-filament cathode set behind focussing ring, and circular tungsten-disk anode, together with the high-voltage and filament-heating circuits.

From the earliest form, the design changed, before the tube went on the market, to essentially that of the present "Universal" type (Fig. 13).

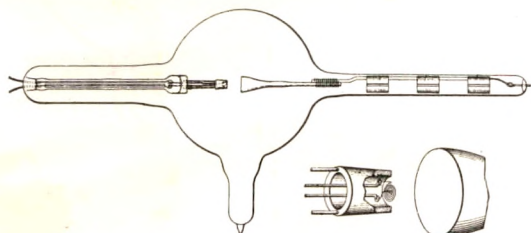


FIG. 13. Later form of hot-cathode tube having the principal features of the present-day "Universal" type.

You are all familiar with the various forms which have appeared since then, both in this country and abroad.

Experience has shown that the main advantages of the hot-cathode tube over the gas tube are the following:

former, making possible a smaller size of outfit.

Long life.

#### *e. Heat Removal from Focal Spot.*

There are only two ways in which appreciable heat removal from the focal area can take place: by direct radiation from the focal spot and by conduction away from the focal spot to other parts of the target from which it can later escape in various ways. The limiting case is that in which the entire focal area is brought to the melting point (if one attempts to go higher than this, the appreciable vaporization of the tungsten leads to great instability in the discharge). With the focal spot at the melting point, the direct radiation amounts to only 3.6 watts per square millimeter. In a tube, then, operating, for example, at 100 milliamperes and 85 kv. (peak) and having a focal area of 17 sq. mm. only about 60 watts, or 1 per cent of the total energy input, would be radiated directly from the focal spot. The large bulk of the energy must then be conducted away from the focal area through the adjacent metal.

The superiority of a copper-backed target to one of solid tungsten for diagnostic work is due to the fact that copper has much greater heat conductivity than tungsten.

Having got the heat away from the immediate neighborhood of the focal spot, there are various ways of removing it from the head of the target.

In copper-backed tungsten targets, the heat flows through the large copper stem to the radiator outside.

Heat removal may, in general, be further expedited by the use of water. This seems especially desirable in the case of high power therapy tubes.

Where the tube is operated in oil, the



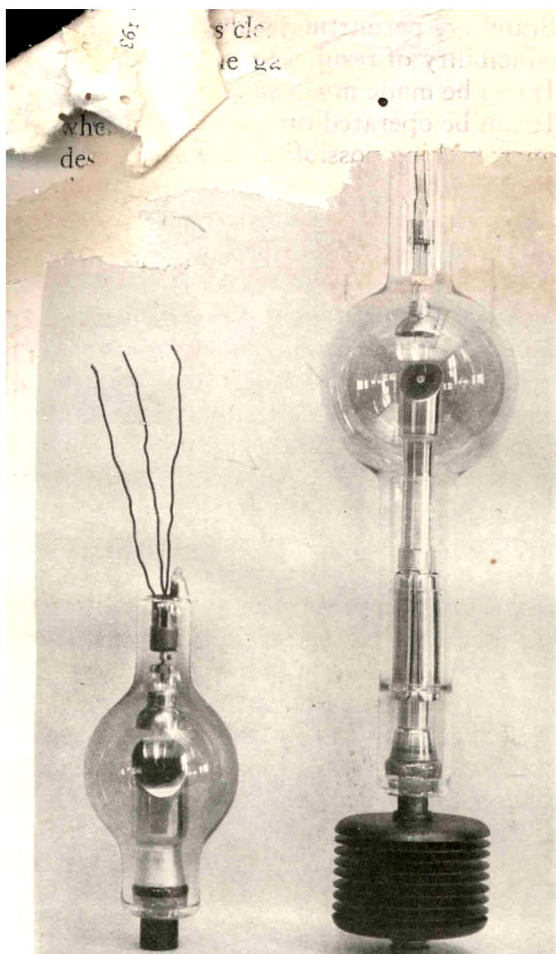


FIG. 14. Air-cooled and oil-immersion types of x-ray tube designed for 30 ma. and 85 kv. (peak), the latter capable of continuous operation at this load 8 times as long as the former.

length of the anode stem may be greatly reduced from that required for operation in air, and, in this way, heat removal may be facilitated. This is illustrated by the two tubes shown in Figure 14, the longer of which can be operated continuously in air at 30 ma. and 85 kv. (peak) for only thirty seconds while the shorter one can be run in oil at the same current and voltage for four minutes.

The neck of the bottle in the cooling process in the diagnostic tube is the resistance, to heat flow, of the metal in the immediate neighborhood of the focal spot.

The first consists in changing from single phase to multiphase current excitation, or, better still, to direct current at constant potential. The main advantage derived from this method is due to the fact that it does not involve the high peak values of current required to give the same average amperage on single phase current. It is these peak values which set the limit in the latter case. The only trouble with this method is that, except in those rare cases where multiphase current is already available in the medical roentgen laboratory, it involves a very considerable increase in the cost of equipment.

The second method consists in the use of a lateral movement of the target face with respect to the cathode rays. This method was advocated by Dr. Elihu Thomson in a patent applied for in 1914 in which he proposed to rotate the target by the

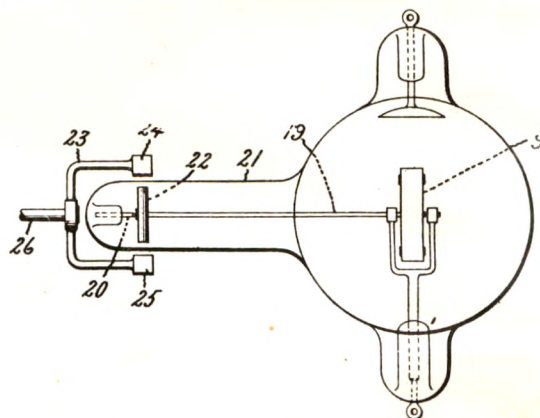


FIG. 15. X-ray tube with rotating target, by Thomson.

help of an electric motor (Fig. 15). I have used this method (Fig. 16), and a tube of

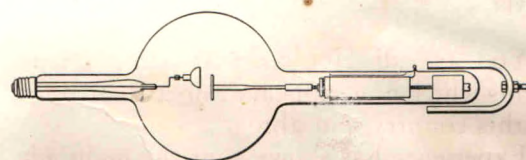


FIG. 16. Hot-cathode x-ray tube with rotating target.



...this type has been described  
I have accomplished the result  
rotating the entire tube (Fig. 17), while  
holding the cathode-ray stream stationary

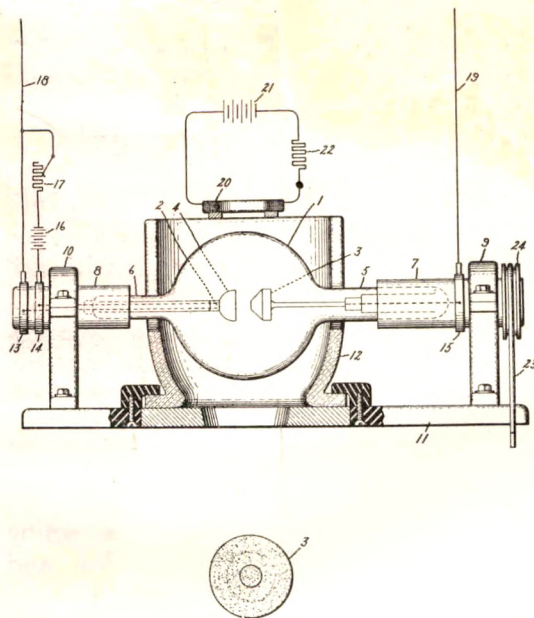


FIG. 17. Rotating x-ray tube.

in space and bent away from the axis of the tube by means of a solenoid, 20, or a small magnet. Rotation of the entire tube has the advantage over rotation of the anode only, in that it does away with the lubricating difficulties attendant upon the use of internal bearings. It also makes easier the removal of heat from the anode by permitting the use of the ordinary solid copper anode stem leading out to a radiator, and even facilitates the action of the latter by rotating it in the air.

By rotation of either tube or target, the allowable energy input per unit area of focal spot can be increased several fold. The future of such a system simply awaits the answer to the question as to whether the gain justifies the complications and limitations involved.

#### *f. Focal Spot Shape and Size.*

In tubes having a target angle of  $45^\circ$ , the focal spot is elliptical, the longer dimen-

<sup>8</sup> *Verhandl. d. deutsch. Röntg.-Gesellschaft.*, 1929, 20, 103-106.

the shape; in the direction of the "central ray," as a circle; and, in the direction of glancing incidence, as a line.

The significance of this change in apparent shape with direction, was recognized by Rollins who, in 1897, published a note on "Why the definition of a reflecting focus X-light tube is better in one plane than another," and said: "In practical work we should be careful to place the tube in such relation to the patient as to see the oval figure at an angle to reduce its length."

The fact that the focal spot appears different in different directions leads unavoidably to a certain astigmatism in the roentgenogram, and this effect increases with ellipticity. If, however, the user will limit himself to a sufficiently narrow cone of rays, taken in the right direction, he can gain considerably by using an elliptical focal spot. The gain consists in an increase in the x-ray intensity per unit of apparent focal area. There is a limit to the ellipticity which can be helpfully employed, for, if it is too great, the rays will have to be taken off at almost glancing incidence, and x-ray intensity falls off rapidly as one approaches close to glancing incidence, especially so if any considerable roughening of the focal area has taken place.

In the line-focus tube, as made by the Philips Company,<sup>9</sup> the ratio of length to breadth is about 3 or 4 to 1.

Regardless of the shape of focal spot, for best diagnostic results, the size of focal spot should always be as small as can be used safely with the load.

This can be accomplished crudely by having a number of tubes with a variety of focal spot sizes.

The "Dofok" tube with its two filaments, gives a choice in the one tube, of two different focal spot sizes, and is therefore a step in this direction.

<sup>9</sup> Goetze, Otto. U. S. Pat. No. 1,590,971.



adjustment being obtained instantly by varying the potential of the focussing member of the cathode with respect to the electron emitting portion. The only objection to thus giving the operator easy control of focal spot size lies in the fact that it complicates matters for him, forcing him to guard constantly against overloading the focal spot.

It would be more ideal if the focal spot size could be *automatically* adjusted to the load. Two methods of automatically adjusting focal spot size to *milliamperage* have been suggested, one by Franke<sup>11</sup> and the other by Kearsley.<sup>12</sup> It would be still more ideal if the adjustment could be to *watts* instead of milliamperage. To be perfect, however, the automatic adjustment for watts should take into account the time factor also, for the shorter the time, the smaller the focal spot which can be used for a given wattage. By further complication, this result also could be accomplished.

The desirability of simplicity in technique may lead one away from the most ideal condition, however, and experience alone will show just how far it is desirable to go in this matter.

#### *g. Tubes for Very High Voltage Roentgen Therapy*

For this purpose, use can be made of cathode-ray tube development,<sup>13</sup> in which it has been shown that tubes can be built for very high voltages by the use of a cascade system. By this method there appears to be no limit to the voltage which can be used.

A two-section x-ray tube of this type has been made to operate very satisfactorily on the pump at 3 ma., and 500,000

The target is placed, not in the bulb, but inside of the copper shield, and near the outer end of the anode arm. In this way most of the

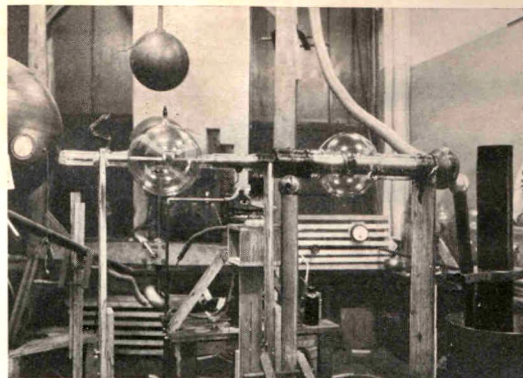


FIG. 18. A 500,000 volt x-ray tube built in two sections.

reflected electrons are kept from returning to the bulb of the second section and getting into the anode arm. With this tube the x-rays are taken out sideways through a hole in the copper shield and through the glass of the anode arm.

The outfit shown in Figure 18 has been sent to Cornell University where Dr. Richtmyer will make a study of the radiations emitted.

For trial therapy a three-section tube is being developed for 900,000 volts, to be operated with the anode grounded. In this case the anode will be made thin and the x-rays will be taken out through it, and through the cooling water, in the direction of the axis of the tube.

### 3. THE HIGH-VOLTAGE GENERATING APPARATUS

#### *a. Early Development.*

The early sources of current, used to operate the x-ray tube, were the induction coil, the static machine and the high frequency coil.

A great stride forward was taken by Snook who developed the Lemp Selector into a very satisfactory high-power source of rectified current.

<sup>10</sup> U. S. Patent No. 1,251,388.

<sup>11</sup> *Brit. J. Radiol.*, 1927, 23, 134-139.

<sup>12</sup> *Am. J. Roentgenol. & Rad. Therapy*, 1930, 23, 170-172.

<sup>13</sup> Coolidge, W. D., *Am. J. Roentgenol. & Rad. Therapy*, 1928, 19, 313-321.



The cathode radiator made possible the very simple type of equipment in which the tube operates directly from the transformer.

The question will be asked as to why a rectifier of any kind should ever be used in series with a self-rectifying x-ray tube for such loads as the latter can by itself safely rectify. There are two reasons for it. In the first place, the focal spot can be made appreciably smaller if the x-ray tube is not required to act as a rectifier. In the second place, an x-ray tube may, by abuse, be brought into such a condition that it will not operate satisfactorily on unrectified current but will still operate in a perfectly satisfactory manner with a rectifier.

In the past it has not seemed practical to operate any half-wave outfit with very high milliamperage owing to the fact that the inverse voltage becomes so high. A recent invention of Kearsley's<sup>14</sup> has, however, greatly changed this. By the simple

#### X-RAY TUBE

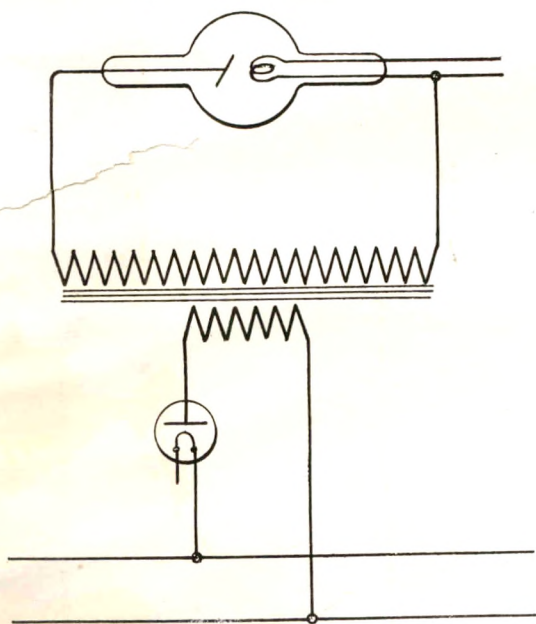


FIG. 19. Diagram of x-ray generator circuit with rectifier in primary to reduce inverse voltage.

<sup>14</sup> *General Electric Review*, 1930, 33, 572.

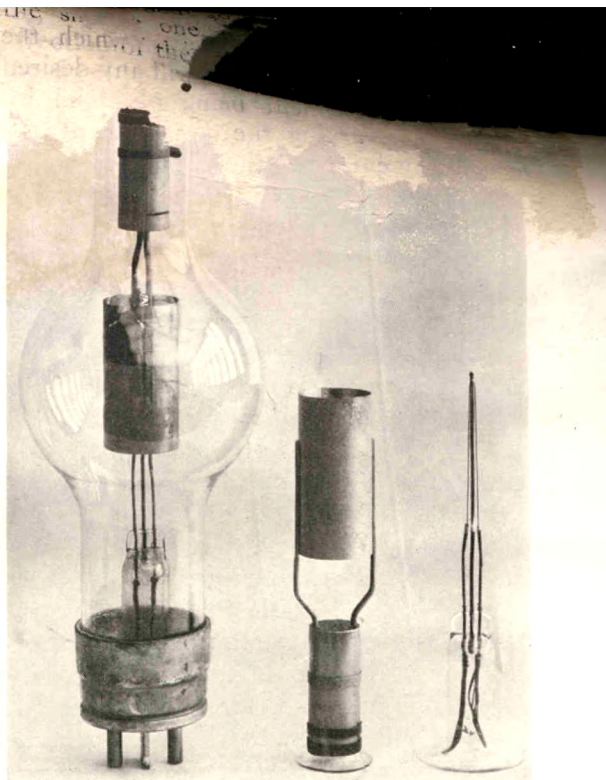


FIG. 20. Early form of kenotron tube and its component parts.

introduction of a mercury arc or other rectifier in series with the primary of the x-ray transformer (Fig. 19) he has increased by several fold the allowable output from a given half-wave outfit.

#### c. The Kenotron Machine.

The kenotron tube was first described by Dr. Dushman, of our laboratory, in 1915. From the beginning, it has offered a number of advantages over the mechanical rectifier, which are so obvious that one may easily wonder why it did not immediately replace the latter in all x-ray generating equipment. The answer is simply that the mechanical rectifier was at that time a highly developed tool and the kenotron tube (Fig. 20) had not been developed to a point where it seemed that it could compete with it in the x-ray field.



The method which would give the result most fully would be suggested by Dr. Langmuir,<sup>10</sup> in a local sr

been shown that the x-ray output milliampere is the same from a kenotron machine as from a properly adjusted mechanical rectifier and higher than from an improperly adjusted one.

There is no valid objection to the idea of a kenotron machine, and the future of this type of equipment will depend entirely upon the satisfactoriness of the kenotron tube itself and upon apparatus design features calculated to minimize as much as possible the needless demands made upon the kenotron tube.

By the use of a multiplicity of kenotron tubes on multiphase current, or with kenotron tubes and condensers, voltage fluctuations at the tube terminals may be reduced to any desired extent, that is, one may approach as closely as he desires to constant potential continuous current.

#### *d. The Induction Coil for Very High Voltage.*

For the production of very high voltage radiation, we have developed a type of induction coil which is relatively cheap and easy to make and very satisfactory (Fig. 22). We started with the idea of using solid dielectric between the primary and secondary, but have found it much

FIG. 21. Form of kenotron tube which has been used in most x-ray generator circuits.

in point of reliability. In a later form of kenotron tube (Fig. 21) which has been used in many x-ray outfits, there has been a variable charging up of the inner surface of the glass. This has been described by Max Wellauer.<sup>15</sup> As a result of this trouble the voltage drop in this type of kenotron tube was a variable quantity, depending on the vacuum. It might be 500 volts or, an instant later, it might be 5000 volts. As, with the bridge connection (full wave rectification) there were two kenotron tubes in series, this introduced an uncertainty of several thousand volts in the voltage supplied to the x-ray tube and was therefore opposed to the exact duplication of roentgenographic results. In still later forms the anode is, as at first, made to surround

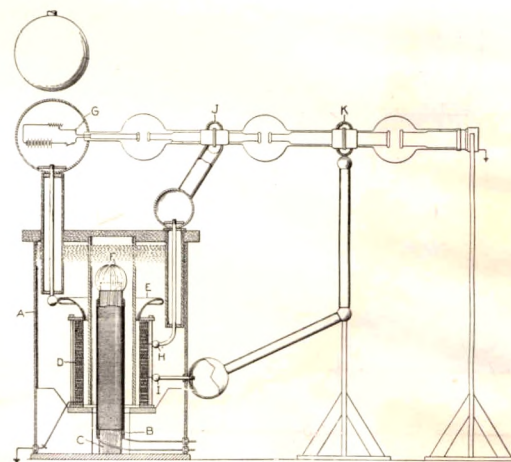


FIG. 22. Diagram of induction coil for supplying 900,000 volts to operate a multisection x-ray tube.



better to rely mainly on oil. The container *A* is a "herkolite" (paper-resin) tank. The primary *B* is a helical coil wound on an insulating tube that surrounds the core *C*. The secondary *D* consists of thin coils placed one on top of the other with paper rings between. The lower end of the secondary is grounded, and the potential difference between secondary and primary then increases as we come up, reaching its maximum at the top of the secondary. Arc-over would take place from the top of the secondary to the primary at about 600,000 volts, were it not for the split aluminum spinning *E*, which electrostatically shields the upper end of the coil and makes it possible to go to about 800,000 volts. At this point, arc-over would take place from the aluminum spinning to the upper end of the core were it not for the spherical shield *F*, which makes it possible to go up to 900,000 volts. The design of the shield *F* is important as it has to be electrically conducting and is located where nearly all of the magnetic flux of the core passes through it. If it were a hollow metal sphere of appreciable thickness, most of the energy delivered to the primary would be wasted in the sphere in eddy currents. The construction indicated has been found satisfactory and consists of a wooden sphere overlaid with narrow strips of sheet aluminum placed as shown, and metallurgically joined at the top and connected to the upper end of the core.

The 900,000 volt lead from *E* passes up through an oil bushing to a 20" hollow metal sphere *G*, consisting of two separable hemispheres, which serves as a container for the storage battery used to light the filament and, at the same time, as a terminal of the measuring sphere gap. To secure other potentials for the intermediate electrodes of a three-section tube, the 600,000 and 300,000 volt taps, *H* and *I*, are brought out to the intermediate electrodes of the tube, *J* and *K* respectively.

The coil is operated from 1200 volt, 60 cycle current, by means of a hydrogen-filled mercury turbine interrupter driven

from a synchronous motor. Such an outfit is to be installed shortly, for experimental therapy, at the Memorial Hospital in New York.

As one end of the secondary is grounded, it will doubtless be possible to operate two such coils in series to produce 1,800,000 volts. It seems, furthermore, as though larger coils could be built in this way for much higher voltages.

It may seem like turning the clock backwards to be working on induction coil developments at this time, and that it would be better to use transformers with kenotron tubes and condensers. For the medical applications, however, it seems as though very little current would be required at these high voltages, and, if this is true, the induction coil seems to be especially suited to the purpose, and for the following reasons: In the first place, there is no need of any auxiliary rectifying device, as the x-ray tube is capable of rectifying its own current. The induction coil gives such an unsymmetrical wave that, even with resistance control, the "useful" voltage will be higher than the "inverse," and, as a result, and without the need of any complications, the sphere gap will indicate the "useful" voltage. Furthermore, owing to the simplicity of the high tension circuit the corona loss can be made negligible. The high magnetic leakage, inherent in the straight open core, and the resistance control, both tend to greatly diminish the electrical hazard; they also make it unnecessary to use resistances in series with the measuring sphere-gap.

#### 4. PROTECTION FROM ELECTRIC SHOCK, AND THE OIL-IMMERSED TYPE OF EQUIPMENT

The hot-cathode tube has brought, in its train, for roentgenographic work, auto-transformer control. This has tremendously increased the danger from accidental contact with the high tension circuit. Even with resistance control, however, the danger would still be very great when using high milliamperage. For these reasons more



...ed in oil in a grounded metal container, promises to become the final type of x-ray generating equipment, for the following reasons:

1. It completely eliminates the electrical hazard.
2. By permitting a great reduction in the length of the anode arm of the tube, and, hence, the anode stem, it gives a corresponding increase in the rapidity of heat removal from the anode, thus allowing increased x-ray output in a given time.
3. It eliminates the effect of altitude and humidity.
4. It eliminates fire-risk in the presence of ether vapor.
5. It gives mechanical protection to the x-ray tube and insures the mechanical integrity of the entire high tension circuit.

For mechanical reasons, it is desirable that the weight and bulk of the head of an oil-immersed outfit should be kept as low as possible. If the movable part were too heavy, its inertia would be troublesome, making it too laborious, even in the absence of all friction, to produce the acceleration and deceleration involved in moving it quickly from one position to another in space. These conditions have seemed to favor half-wave operation, and this, because of the "inverse" problem, has limited the capacity of such outfits. Kearsley has recently found, however, as has already been mentioned, that with half-wave operation, "inverse" can be greatly reduced by the use of a mercury arc or other rectifier in series with the low voltage primary circuit. In this way a several fold increase in capacity may be made without increase in size and in fact without any change in the movable member.

##### 5. PRECISION TIMING IN FAST ROENTGENOGRAPHY

Generally speaking, it seems questionable whether very high speed roentgeno-

graphic work has, in the past, been done in a factory. The reason for this is to be found in the fact that with increase in speed has in general been a decrease in the precision of the work. In other words, it has not been possible to duplicate results closely. This is partly due to imperfections in the timing device itself but, more especially, to the fact that the time taken in actually opening the circuit was so variable depending on whether it happened that the event was scheduled to take place at zero, or at the peak, or at some intermediate point in the voltage wave.

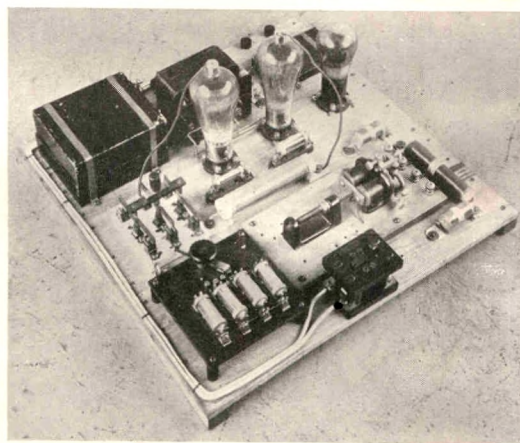


FIG. 23. Kearsley vacuum-tube time switch. Upper left: Condenser. Lower left: Adjustable rheostat. Upper right: Thyatron tubes. Lower right: Relay.

To get precision timing for high speed work, it is desirable to make and break the primary circuit at zero on the voltage wave. This result has been accomplished in two ways by Kearsley.<sup>16</sup>

One of these is a vacuum tube time switch, with no moving parts, consisting essentially of a condenser which is first charged to a definite potential and then discharged through an adjustable rheostat. When the condenser voltage has dropped to a certain value, in a time determined by the value of the resistance used, the x-ray circuit is opened through the control of the potential of a grid in a small thyatron

<sup>16</sup> To be published in the *General Electric Review*.



other one is a synchronous motor time switch (Fig. 24), which is so designed that the exposure may be started zero, and then, through grid control of the thyratrons or pliotrons, stopped on after the desired number of current pulses.

This form of time switch is particularly noteworthy for its high precision which is obtained through the use of the synchron-

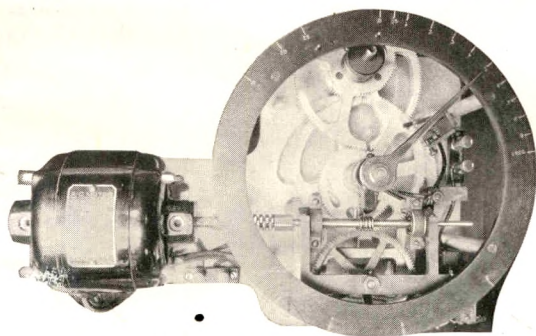


FIG. 24. Kearsley mechanical time switch.

ous giv. through. The twenty-five second range. The accurate setting easier, and there is much less chance of error than where a double scale and selector switch are employed.

An unusual feature of this switch is that the motor does not operate continuously but starts an instant before the exposure is to be made and stops when the control switch is released. This not only insures quietness when not in actual use but greatly reduces wear, and simplifies lubrication problems.

In the preceding I have attempted to emphasize some of the fundamental principles involved, in order to show why x-ray generating apparatus has its present limitations and to indicate in a few cases how the capabilities of the apparatus may be increased in the future.





attention must be given to the matter of electrical protection.

For di-  
he x-

ERLAIN

San Francisco Junior University, School of Medicine  
San Francisco, California

THE somewhat controversial subject of "sacroiliac slip" appears to owe its modern origin to Goldthwait and Osgood, who published in 1905 a most important contribution to this subject. Their paper entitled, "A Consideration of the Pelvic Articulations from an Anatomical, Pathological and Clinical Standpoint"<sup>2</sup> serves very well as a starting point for a modern study of this subject. In passing, however, it is interesting to follow Goldthwait and Osgood and go back a bit further to the paper of Snelling, published in 1870, entitled "Relaxation of the Pelvic Symphyses during Pregnancy and Parturition."<sup>4</sup> According to Snelling, observations of this condition date back to the time of Hippocrates.

The work of Goldthwait and Osgood included a thorough report of the literature, but they were unable to find any allusion to such affections of the pelvic joints apart from pregnancy. Their own work began with a consideration of these joints in connection with pregnancy. They later convinced themselves that certain cases occur, in the absence of pregnancy, in connection with menstruation, and finally they successfully applied the same considerations to explain certain cases of low back and leg pain and disability, occurring both in men and in women.

Since the first report of Goldthwait and Osgood, much has been written upon this subject. Apparently the medical profession greeted enthusiastically this possible explanation for a large group of low back conditions, in which both diagnosis and treatment had been unsatisfactory. The diagnosis "sacroiliac slip" came into vogue, with the almost unanimous consent of the

orthopedists as well as the rest of the profession.

There has since been some reaction that today there are many physicians either doubt the existence of such a thing as sacroiliac slip in any important number of patients, or frankly believe that such displacements are anatomically impossible. Roentgenologists have been particularly active in throwing doubt upon the existence of displacements of the sacroiliac joints, apart from the occasional gross dislocations in connection with severe injuries. The point of view of Baetjer and Waters may be taken as more or less typical. In their text, "Injuries and Diseases of the Bones and Joints," 1921, written from the roentgenological viewpoint, they dismiss the whole subject of sacroiliac displacement or slip, in the following words: "The so-called sacroiliac subluxations, in the writers' opinion, do not exist. The joint is of the saw-tooth variety and before a slipping could take place these saw tooth edges would have to be broken. These conditions must be ligamentous sprains."

Perhaps the tendency for roentgenologists to discredit the diagnosis of sacroiliac slip springs from repeated failure to demonstrate such displacements upon the roentgenogram even where the cases are clinically typical.

In 1919, Dr. Thomas A. Stoddard of San Francisco, called my attention to the fact that while the usual roentgen examination of the sacroiliac joints could be expected to show a considerable displacement in a longitudinal direction, displacements in a dorsoventral direction would be difficult to identify upon a roentgenogram, and rotatory displacements about a trans-

\* Read at the Twenty-third Annual Meeting, American Roentgen Ray Society, Los Angeles, Sept. 12-16, 1922. Presented in summary at the Fifty-eighth Annual Meeting, California Medical Association, Coronado, May 6-9, 1929.



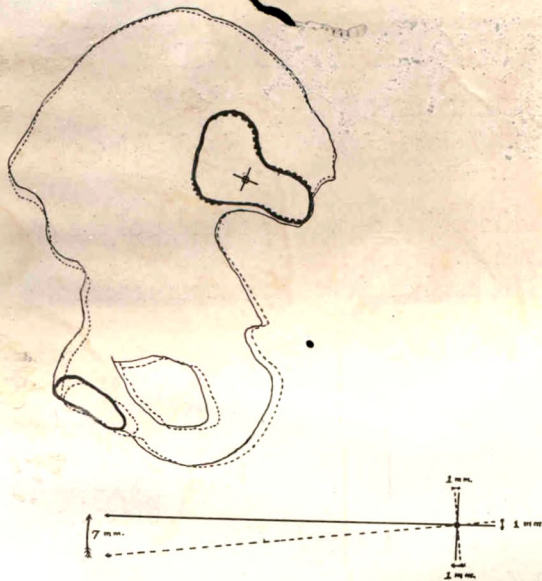


FIG. 1. Diagram of medial aspect of innominate bone. When sacroiliac joint motion occurs, it is rotatory, with axis of rotation within the joint. The pubis exhibits an excursion which is magnified in proportion to its distance from the axis of rotation.

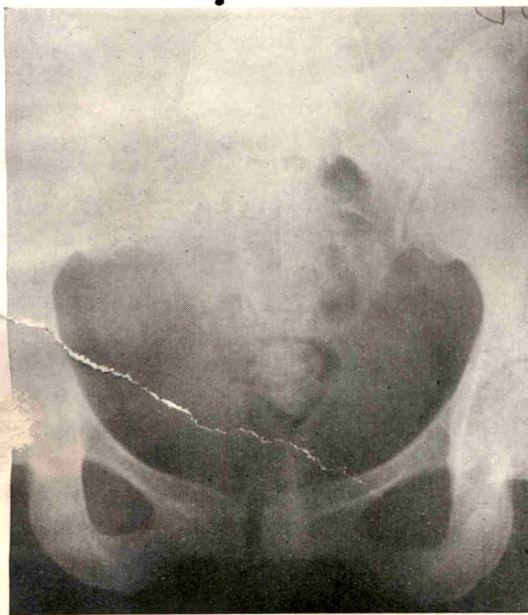


FIG. 2. This patient (see also Fig. 7) was suffering from a sacroiliac subluxation and relaxation. The roentgen appearance of the sacroiliac joints themselves is not remarkable. But the left pubis is higher than the right, and there is an increase in the spacing between the pubes.

verse axis would, in all probability, never become apparent upon such roentgenograms. This idea resulted in a change in technique so that for the past ten years all roentgenograms of the sacroiliac region have been made so as to include the symphysis pubis and entire pelvic brim in one stereoscopic examination. The result has been a most gratifying roentgen corroborations.

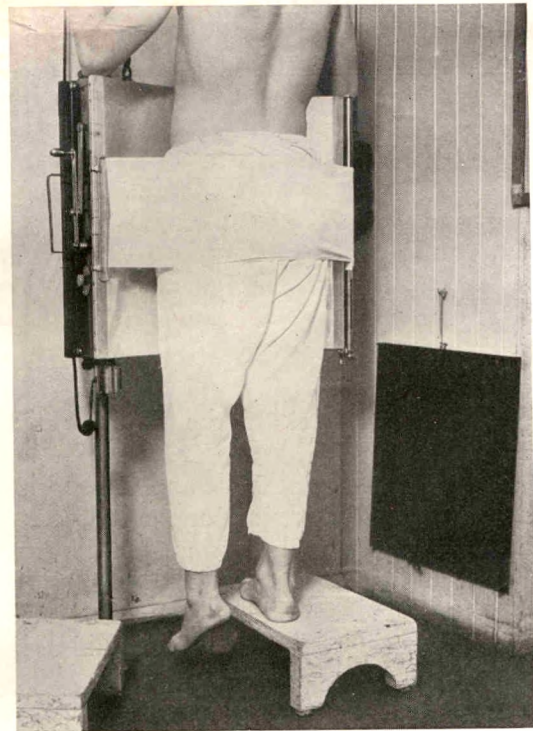


FIG. 3. Photograph of patient in position for one of the special anterior projections of the symphysis pubis. Note Potter-Bucky diaphragm, and 3 inch steps, one of which has been removed from under the left foot, leaving weight on the right leg.

tion of the clinical concepts of Goldthwait and Osgood, and it is interesting to note that in their original paper they pointed out that motion in the sacroiliac joint, when it occurs, is rotatory about a transverse axis normal to the articular surfaces.

For the purpose of the roentgen study of the sacroiliac joint, let us conceive of the pelvic arch as the long arm of a kymographic recorder, and the symphysis as its point, describing during any rotatory



sacroiliac displacement, a magnified stroke (see Fig. 1). This excursion of the pubis will be capable of demonstration upon the roentgenogram unless an exactly equal and symmetrical displacement in the other sacroiliac has resulted in both pubes rising or falling to the same extent. Naturally such an exactly equal and symmetrical displacement in the two sacroiliacs would hardly be the rule, so that we can expect to find in a majority of cases of sacroiliac displacement a difference in elevation of the pubes and an asymmetry of the pelvis (see Fig. 2).

Shortly after our discovery that sacroiliac joint motion could be thus demonstrated at the symphysis pubis, we developed a technique for detecting and measuring the degree of movements of these joints with alternation of weight-bearing from one leg to the other. The

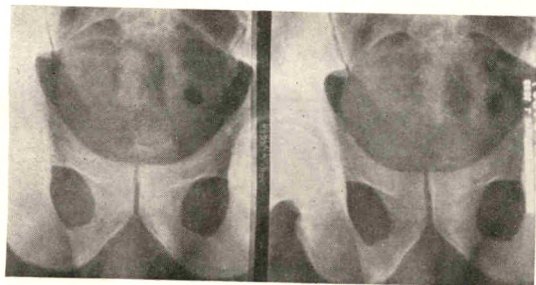


FIG. 4. The special anterior projections in a normal male. Usually there is no measurable displacement in the normal male, but motion up to 0.5 mm. at the pubis is considered within normal limits.

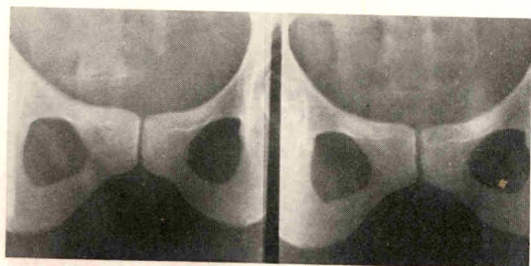


FIG. 5. The "special studies" in a normal female. Motion at the pubis in the female may be as much as 1.5 mm., though 1 mm. is more usual. More than 2 mm. has invariably been accompanied by symptoms, in our experience, and more than 1 mm. may be significant.

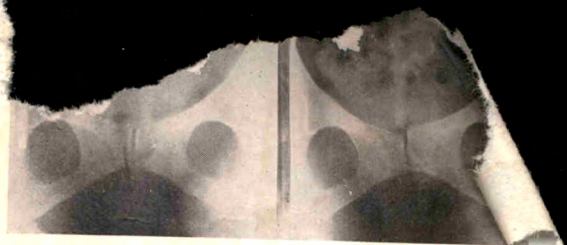


FIG. 6. The special studies in a case of marked sacroiliac joint relaxation. The patient's weight is the side which bears the "marker" or label.

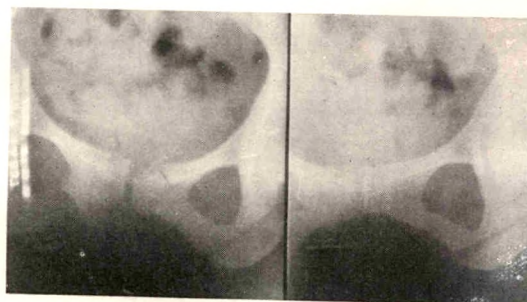


FIG. 7. This patient exhibited asymmetry and gaping at the symphysis even when lying supine (see Fig. 2), but the true condition, shown by the "special studies," is relaxation, not "slip."

patient stands on a pair of steps or blocks, 3 inches high, facing a vertically disposed Potter-Bucky diaphragm. With a properly centered beam and an 8"X10" film, an anterior projection of the symphysis is obtained after the step has been removed from under the left foot (see Fig. 3). The lead marker, reading right, is placed on the right side. In the second picture, with weight bearing on the left leg, the marker reading left, is placed on the left side.

With this technique, we first studied normal individuals, with results as indicated in Figures 4 and 5. Normal movements measured at the pubes amount to from 0 to 0.5 mm. in the male, and from 0 to 1.5 mm. in the non-pregnant female.\*

\* Very early in pregnancy the pelvic joints become relaxed, and there is reason to believe that some of the backaches of menstruation may be due to a temporary sacroiliac relaxation. Further studies are being made with reference to the possibility of roentgen demonstration of cyclic (menstrual) changes in the degree of motion of the female pelvic joints.



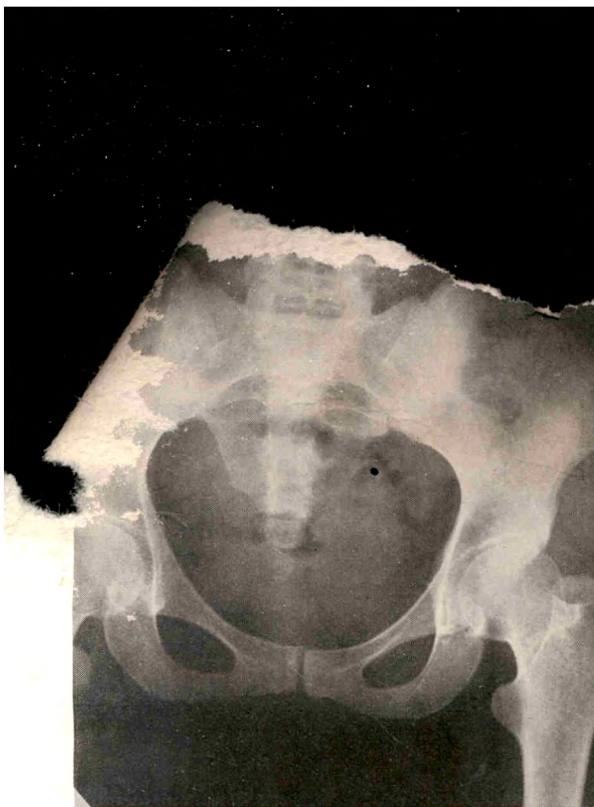


FIG. 8. Pelvis of Mrs. B. This film, part of a stereoscopic study, shows elevation of right pubis due to rotation of right innominate bone. At the time this study was made, patient presented the typical clinical picture of "right sacroiliac slip."

In the ten years since the above described technique was adopted, we have found our most fruitful field in the realm of sacroiliac "relaxation" (see Figs. 6 and 7), but occasionally we have been able to demonstrate what is apparently a fixed slip. Mrs. B. (Figs. 8 and 9) presented the painful picture of a right sacroiliac slip (in accordance with the clinical concepts of Goldthwait and Osgood). The roentgen examination disclosed a right innominate bone rotation (right pubis higher than left). After manipulation and bed rest, all symptoms subsided. Some months later this patient was brought back and examined again, and the innominate bones were found to be quite symmetrically disposed.

At this point, attention is called to four important points: (1) In studying the pelvis for an asymmetry of the type illustrated in Figures 8 and 9, the entire pelvic brim must be studied, stereoscopically. The pubes themselves are sometimes develop-

mentally different from each other, and we have seen a hypertrophic arthritic change build up one pubic margin higher than the other. These local changes will not be confused with true innominate bone rotations if the observer will study, in the stereoscope, the symmetry or asymmetry of the brim of the pelvis as a whole.

(2) We cannot claim to have proved that the so-called "slip" is the primary factor in the acute low back episode called "sacroiliac slip." Our definite demonstration of innominate bone rotation in these cases could be equally well explained by assuming certain muscle spasms, pulling the rotated innominate bone from its usual position. No attempt is made, at the present time, to decide which is cause and which is effect.

(3) In our own experience, the patient's acute sacroiliac symptoms have almost invariably been on the side of the high pubis. In only about a tenth of the cases have they been on the side of the low pubis. In this

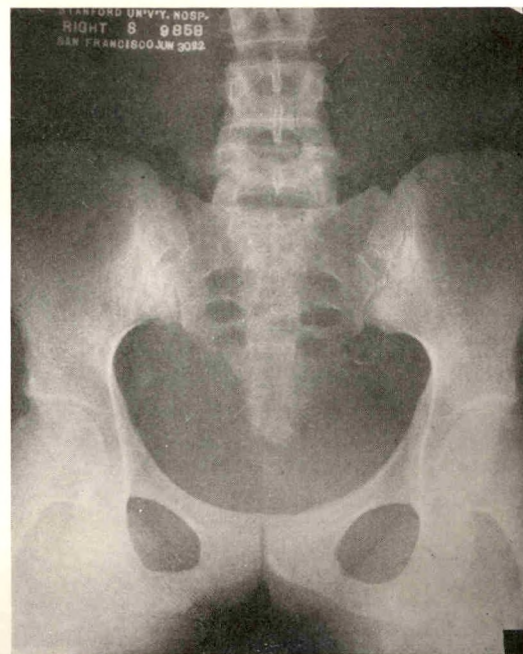


FIG. 9. Same case as Figure 8. This study was made at a time when the patient was free from sacroiliac symptoms. Note the comparatively symmetrical pelvis.





FIG. 10. Tuberculosis of the symphysis pubis. This patient did not complain of any abnormal sensations at the symphysis, but had all the symptoms of a "sacroiliac slip" on the side of the high pubis.

connection, attention is called to the anatomy of the ligaments of the sacroiliac joint. The strongest ligaments run in such a direction that the fibers are tightened when the pubis moves caudad and loosened when the innominate rotates in the opposite sense.

(4) The ligaments at the symphysis pubis may be of considerable importance to the stability of the sacroiliac joints. We have several cases which suggest that de-

structive  
produce  
symptoms in  
Fig. 10).\*†

#### SUMMARY

The ordinary roentgen examination of the sacroiliac region does not demonstrate the presence of sacroiliac relaxations or luxations. For about ten years, we have successfully used the following technique for the demonstration of these conditions. Five films are exposed—a stereoscopic pair in posterior projection, patient supine on the Potter-Bucky diaphragm table, with film size and centering adjusted so as to include the symphysis pubis and the entire pelvic brim in the field; a lateral projection centered at the lumbrosacral junction; and two anterior projections of the symphysis pubis, patient standing, facing a vertical Potter-Bucky diaphragm, as illustrated in Figure 3, one film being made with the patient's weight borne on the right leg, the other with his weight on the left leg.

The above method of examination has served to successfully diagnose "sacroiliac slip" (innominate bone rotation with more or less fixation), and sacroiliac relaxation.

\* The author wishes to express his sincere thanks to Drs. Leonard W. Ely and Arthur L. Fisher, of the Department of Orthopedic Surgery, for their valued help and clinical advice.

Dr. Ely recently called my attention to the work of Allen.<sup>1</sup> Apparently he has arrived, independently, at a very similar technique for the roentgen examination of the sacroiliac region.

† In 1928, Dr. Sante,<sup>3</sup> of St. Louis, who heard this paper read in September, 1922, wrote me that he had corroborated these concepts in a very large series of cases.

#### REFERENCES

1. ALLEN, H. R. The ilio-sacral joint. *Indianapolis M. J.*, 1923, 26, 151-155.
2. GOLDTHWAIT, JOEL E., and OSGOOD, ROBERT B. A consideration of the pelvic articulations from an anatomical, pathological and clinical standpoint. *Boston M. & S. J.*, 1905, 152, 596-601.
3. SANTE, L. R. Personal communication.
4. SNELLING, FREDERICK G. Relaxation of the pelvic symphyses during pregnancy and parturition. *Am. J. Obst.*, 1870, 2, 561-596.





## EFFECT OF PHRENICECTOMY ON PULMONARY CAVITATION

By WALTER I. WERNER, M.D., and E. J. O'BRIEN, M.D.

PONTIAC, MICHIGAN

DETROIT, MICHIGAN

IN RECENT years pathologic anatomists and clinicians have pointed out the important rôle that cavities play in the prognosis of pulmonary tuberculosis. The classical roentgen pictures of pulmonary cavities with their draining bronchus leading to the hilus, and fluid levels are described in any standard atlas of roentgenology. Rarefied areas in the center of infiltrations, and faintly outlined annular shadows, with few exceptions are now classified as cavities. In cases where the classical physical signs of cavity are absent the roentgenogram should be the deciding factor. Various authors claim that from 5 to 80 per cent of all pulmonary cavities in tuberculosis are silent. These silent cavities are of at least two kinds: (a) absolutely mute, that is, those which exhibit no adventitious breath sounds at all, and (b) relatively silent, that is, those cavities which lack the classic cavernous signs but manifest other adventitious sounds such as bronchovesicular breathing and moist rales. The examination of the sputum for elastic fibers and tubercle bacilli is an aid in arriving at a diagnosis of cavitation. As the cavities diminish in size, the amount of sputum and number of tubercle bacilli decrease, but when the cavities reopen or grow larger, both increase. Tubercle bacilli

in the sputum in the presence of an annular shadow in the roentgenogram, strengthens the diagnosis of the latter as cavitation. Pinner, from histological studies and serial roentgenograms, has described three types of cavities. Roentgenologically, these three types are, briefly, as follows: (1) small, multiple cavities in densely infiltrated parenchyma, the roentgen appearance of which is frequently described as "both eaten areas;" (2) sharply defined,

Fig. 1. Completely round or slightly oval cavity, surrounded with heavy perifocal infiltration, both apical.

tration or with thin, clearly defined borders, and (3) irregularly shaped cavities with dense walls, often of grotesque shape with marked irregularities in the walls.

Based upon the above classification a study of 200 cases of pulmonary tuberculosis with cavities 3 cm. or larger in diameter, was made. One hundred cases received routine rest cure. In 75 of the other group only phrenicectomy was done, while it was performed as an accessory to artificial pneumothorax in 25. The object of this paper is to determine the influence of phrenicectomy on the pulmonary cavity.

In the group of 100 cases which received no surgical treatment there were 66 cases with oval cavities and 34 with fibrotic walled cavities. Spontaneous closure of the cavities was observed in 14 cases. Serial roentgenograms revealed gradual shrinkage of the cavities to a small cloudy spot. These changes were accompanied by a decrease in the sputum and physical signs. Cavities 4 to 6 cm. in diameter have closed within a few weeks or months, only to reopen within a short period. The sputum was positive for tubercle bacilli in all of these cases. It became negative in 12 cases where the cavities closed. The cavities reopened in 6 cases and the sputum again became positive. The average stay in the sanatorium for these patients was three years. Forty per cent of these patients died during their stay in the hospital.

Table 1 shows the fate of the cavities in the group of 100 patients who received routine rest cure.

Phrenic exeresis should be done in tuberculous lesions requiring some form of collapse therapy but which are not considered sufficiently advanced for the use of artificial pneumothorax. It should also be done before a lung having an extensive lesion is



	Larger		Stationary		Closed	
	No.	Per cent	No.	Per cent	No.	Per cent
Thin walled (66)	46	69.7	8	12.1	12	18.1
Thick walled (34)	15	44.0	17	50.0	2	5.8

allowed to reëxpand after being kept down with pneumothorax for a period of years. In old fan-like mixed lesions at the apex, with or without cavity, that can rarely be controlled by pneumothorax, it is especially beneficial. In the thin-walled, infraclavicular cavities (2-4 cm. in diameter) left after an exudative lesion has attempted to heal by excavation, phrenicectomy is indicated. Phrenic exeresis is used as an adjunct to pneumothorax when adhesions to the lateral wall or apex prevent proper collapse of cavities. It is also indicated as a preliminary measure to thoracoplasty. Patients who need thoracoplasty but are poor risks, often obtain sufficient improvement following the operation on the nerve to prolong life or ease symptoms such as persistent cough and fever.

In the 100 cases in which the phrenic nerve was removed marked changes were observed in the roentgenograms.

Table II shows the fate of the cavities in the 100 surgically (phrenicectomy) treated cases.

In the group of 36 cases where only phrenicectomy was done there were 24 cases with thin-walled cavities and 12 cases with early infiltrations and moth eaten areas. Of the former group the cavities closed in 16, contracted in 6 and grew larger in 2; while in the latter group all closed. The sputum was positive for tu-

bercle bacilli before operation in 24 cases and negative in 12. It was negative in 32 cases and remained positive in only 4 cases following the operation.

In 9 cases in which pneumothorax had been attempted and failed on account of pleural adhesions, phrenicectomy was done. The cavities closed in 2 cases, contracted in 6 and remained unchanged in one. Tubercle bacilli were present in the sputum of 8 cases and not demonstrable in one before the operation. After the operation the sputum became negative in 4 cases, remaining positive in 4.

Diaphragmatic paralysis was induced in 23 cases that were under artificial pneumothorax compression, in order to release adhesions and bring about the closure of cavities. There was relaxation of the adhesions with closure of the cavities in 14 cases, the cavities contracted in 5 and remained unchanged in 4. Tubercle bacilli were demonstrated in the sputum of all these cases before operation. It became negative in 11 cases after the operation. The phrenic nerve was removed in 2 cases during the reëxpansion of the lung. In these 2 cases it was easier for the reëxpanding lung to fill the chest completely preventing a compensatory emphysema.

On 30 patients the operation was done to be followed by thoracoplasty. In 4 cases the cavities closed, decreased in 17,

TABLE II

	Larger		Stationary		Decreased		Closed	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Thick walled (21)	4	19.0	8	38.0	9	42.8	0	0
Thin walled (67)	3	4.4	1	1.5	26	38.8	37	55.3
Moth eaten (12)	0	0	0	0	0	0	12	100



Treatment	Cavities closed	Cavities decreased in size	Cavities increased in size	Cavities closed and reopened	Sputum became negative
	Per cent	Per cent	Per cent	Per cent	Per cent
Routine sanatorium care. Bed rest.	14	25	61	42.9	0
Routine sanatorium care with phrenicectomy.	49	35	7	0	45.8

remained unchanged in 4, and grew larger in 1. In all of these cases the sputum was positive for tubercle bacilli. It became negative in the 4 cases where the cavities closed.

Table III presents a summary of the fate of the cavities in the group of cases that were treated with bed rest and the group of cases that were surgically treated.

Since the occurrence of excavations in pulmonary tuberculosis points to an unfavorable prognosis, the figures presented of the results following phrenicectomy on

cavitation have been very encouraging. It is not the object of this study to discuss the clinical course, prognosis and end-results of these cases. Only the immediate effect of phrenicectomy on pulmonary cavitation is reported.

#### CASE REPORTS

CASE I. (Figs. 1, 2 and 3.) B. R., white female, aged twenty-six, admitted to the sanatorium, November, 1923, with an advanced bilateral pulmonary tuberculosis with cavitation. The sputum was heavily positive for

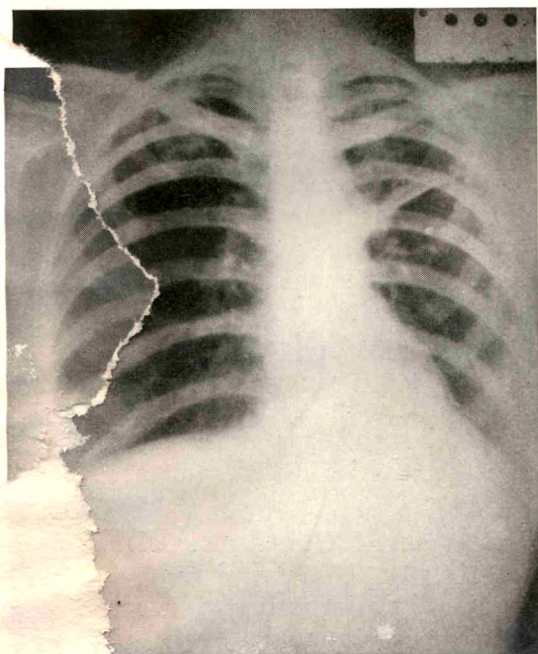


FIG. 1. Case I. November, 1926. Shows an advanced bilateral pulmonary tuberculosis with cavitation in the upper lung regions.

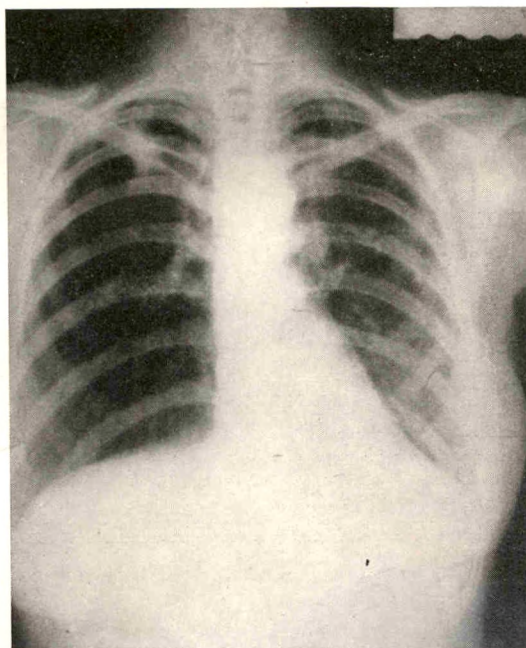


FIG. 2. Case I. August, 1928. There has been absorption of the peripheral and closure of the cavities. Phrenicectomy was done on Sept. 1927, following which there was relaxation of the lungs with closure of the cavity. The sputum became negative for tubercle bacilli.



# APPENDICITIS

WALTON, M.D., and SAMUEL WEINSTEIN, M.D.

BALTIMORE, MARYLAND

Diagnosis of chronic ap-  
pendicitis has attained a practical state  
through the medium of the  
roentgenoscope. In recent years, numerous  
articles have been written dealing with its  
advantages and demerits, and it is the object  
of this paper to present our observations  
based on a series of 1000 consecutive gas-  
trointestinal examinations.

Table II shows that out of 152 cases in  
which a diagnosis of chronic appendicitis  
was made, the appendix was visualized  
in 134. In 18 cases, we were unable to  
visualize the appendix at any time, but  
felt that a positive diagnosis of chronic  
appendicitis was justifiable.

Until 1911, little mention was made of  
the visualization of the appendix roent-

genographically. This was probably due  
to the contrast meal in use at that time.  
With present day methods there is usually  
no difficulty in outlining the appendix. In  
our routine gastrointestinal work, we de-  
pend largely upon the roentgenoscope for  
determining the presence of any pathologi-  
cal condition in the appendix, using films  
chiefly to confirm the roentgenoscopic find-  
ings. We usually make several films of the  
stomach immediately following the first  
roentgenoscopic examination, and these are  
followed by six, eighteen and twenty-four  
hour films. When there is delayed empty-  
ing of the colon, forty-eight and seventy-  
two hour observations are made. This  
routine gastrointestinal examination is fre-  
quently followed by a barium enema.

TABLE I  
THE INCIDENCE OF THE VARIOUS TYPES OF GASTROINTESTINAL PATHOLOGY  
ENUMERATED IN THE ORDER OF THEIR FREQUENCY

	Number	Percentage
Negative findings.....	220	22.0
Chronic appendicitis.....	152	15.2
Visceroptosis.....	112	11.2
Right upper quadrant pathology, including gall-bladder disease.....	108	10.8
Gastric carcinoma.....	78	7.8
Gastric ulcer.....	76	7.6
Colon stasis.....	69	6.9
Duodenal ulcer.....	56	5.6
Left and right lower quadrant adhesions.....	70	7.0
Pylorospasm.....	16	1.6
Colitis.....	10	1.0
Diverticulitis.....	8	0.8
Carcinoma of the cecum, ascending, descending and transverse colon.....	7	0.7
Carcinoma of the sigmoid.....	6	0.6
Cardiospasm.....	4	0.4
Esophageal carcinoma.....	2	0.2
Peritonitis with intestinal obstruction.....	2	0.2
Carcinoma of the pancreas.....	1	0.1
Carcinoma of the duodenum.....	1	0.1
	1	0.1
	1	0.1

It is not unusual for the pain to be referred to the right side of the abdomen. This can usually be detected by comparing the left with the right side. It is also essential to ascertain whether the pain is constant, intermittent, or colicky.

TABLE II  
THE DISTRIBUTION OF THE AGES, IN THE VARIOUS GROUPS AS WELL AS SEX, IS SHOWN

Age	Number	Appendix Visualized	Appendix not Visualized	Male	Female
1 to 10	6	4	2	2	4
10 to 15	2	1	1		2
15 to 20	3	2	1	2	1
20 to 30	38	34	4	15	13
30 to 40	52	45	7	39	23
40 to 50	30	27	3	18	12
50 and over	21	21	0	11	10
	152	134	18	87	65

TABLE III  
PERCENTAGE OF AGREEMENT BETWEEN THE ROENTGEN AND CLINICAL FINDINGS IN THE 152 CASES

	Number	Percentage
Patients discharged with diagnosis of chronic appendicitis after a most careful clinical investigation.....	86	56.6
Patients operated upon and diagnosis of chronic appendicitis confirmed.....	47	30.9
Patients in whom the diagnosis was not confirmed either clinically, or by operation.....	19	12.5
	152	100

The pain varies from day to day. Occasionally, the patient will complain of pain over the appendix upon pressure the first day, but the following day, deep palpation will reveal no discomfort whatever. These observations have been described by Bierman and he attributes them to varying degrees of chronic pressure. When the cecum is palpated deep palpation is made, there is a marked increase in the tenderness of the cecum.

In the series herewith presented, the diagnoses were based on the following findings:

#### A. Direct Evidence.

1. A visualized appendix tender to palpation.
2. Del-



## adhesions:

lix in parts

B. Ir <sup>1</sup> de

1. Ileo colonic stasis.

2. Spas atony of the cecum.

3. Stasis of the cecum after the enema

lon is empty.

100

125501  
er 140

- I. In a routine study of 1000 consecutive gastrointestinal examinations, there was positive evidence of a pathological appendix in 152 instances, or 15.2 per cent.

2. This diagnosis was confirmed either clinically or at operation in 133 cases, or 77.5 per cent.

3. The incidence of appendicitis was noted to be greatest between the ages of twenty and fifty years. •

4. Of the direct evidences, the visualized appendix which empties slowly and is persistently tender to palpation is the most common.

5. Of the indirect evidences, the ileal and colonic stasis are the most common.

6. An even greater percentage of correct diagnoses will be obtained if the clinical studies are closely correlated with the roentgen findings.

## REFERENCES

1. BIERMAN, M. I. Chronic appendicitis; bases for varied clinical manifestations. *Radiology*, 1925, 5, 152-157.
2. CASE, J. T. Further x-ray studies on the ileocecal valve and the appendix. *AM. J. ROENTGENOL.*, 1914, 1, 376-388.
3. DEAYER, J. B., and RAVDIN, I. S. End-results of 500 cases of chronic appendicitis. *Arch. Surg.*, 1923, 6, 31-40.

4. DOWDEN, J. W. Diagnostic difficulties in chronic appendicitis. *Brit. M. J.*, 1927, 2, 1066.
5. HURST, A. F. *Arch. Roentg. Ray.*, 1914, 19, 249.
6. IMBODEN, H. M. Roentgen diagnosis of lesions of vermiform appendix. *AM. J. ROENTGENOL.*, 1915, 2, 581-591.
7. QUIMBY, A. J. Differential diagnosis of the appendix by aid of the Roentgen ray. *N. York M. J.*, 1913, 98, 697-705.



# STUDIES ON THE SHADOW PRODUCED BY COLLARGOL\*

## BROMINOL-LIGHT ON THE DOG

BÉLA HALPERT, M.D.

Pathology, University of Chicago

EXPERIMENTAL

By ALLAN

PRILL

From the Department of Surgery and the

CHICAGO, ILLINOIS

THE content of the biliary vesicle may be rendered opaque to roentgen rays by a direct or an indirect method. The direct method consists of withdrawing and replacing the content of the gall-bladder by a radiopaque substance. The indirect method is that invented and perfected by Graham and his coworkers (1924).<sup>7,8</sup> This consists of intravenous or oral administration of a radiopaque substance which appears in the bile and reaches the lumen of the gall-bladder per vias naturales. Inasmuch as the bile is resorbed faster than the radiopaque substance, the latter eventually becomes concentrated enough to cast a shadow roentgenologically.

The present studies are concerned with the direct method of visualization of the biliary vesicle, and were undertaken with the aim of evaluating the available data obtained by this method and of gaining further information regarding the mechanism of the function of the gall-bladder.

### HISTORICAL REMARKS

Burckhardt and Müller (1921)<sup>5</sup> were the first to apply the direct method of visualization of the gall-bladder in dogs and human beings. In their preliminary studies on the cadaver they used collargol or air or both as contrast medium, and later either collargol or pyelon. They opened the abdomen and filled the gall-bladder with collargol in three dogs and with pyelon in one. In two of the dogs whose gall-bladder was filled with collargol a shadow

gall-bladder content was obtainable twenty-two and thirty-six hours immediately; the shadow persisted longer in the dog in which previous to the

injection the cystic duct was ligated. The shadow produced by pyelon disappeared at about the forty-eighth hour following the injection. In one patient collargol and in another pyelon was injected into the gall-bladder under local anesthesia, and the roentgenographic findings were verified by a subsequent operation. In four more patients the procedure (with collargol) was applied under general anesthesia. In two of these the procedure was unsuccessful, because of atrophy of the vesicle in one, and tumor in the other. In all of these patients laparotomy and radical operation followed the attempt of cholecystography.

Abramson (1924)<sup>1</sup> injected sodium iodide or neosilvol (Parke-Davis), a silver-protein-iodide compound, into the gall-bladder of six dogs and studied the roentgen shadows thus produced while the animals were recovering from anesthesia, after anesthesia, and a number of days following the operation. Abramson made the following observations: (1) Spontaneous expulsion of about 3 c.c. of the content of the gall-bladder occurred in a dog which had been cholecystostomized five days previous to the observation and whose gall-bladder was visualized by the injection (through a tube) of 4 c.c. of a 150 per cent solution of sodium iodide. (2) By manual pressure on the abdominal wall the content of the gall-bladder could be forced to leave the viscus. (3) Movements of the animal did not result in expulsion of material from the gall-bladder.

Potter and Mann (1926)<sup>13</sup> filled the gall-bladder of a dog through a cholecystostomy tube with "barium solution" and

been conducted under the joint auspices of the Douglas Smith Foundation for Medical Research and the  
Memorial Institute.



They thus made use of Boyden's observation<sup>3</sup> that a meal of egg-yolk and cream would cause the distended gall-bladder of a cat nearly to collapse within an hour and three-quarters, and of Whitaker's method of visualizing the biliary vesicle. On roentgenograms taken at frequent intervals Whitaker and Boyden observed that the iodized oil entered the cystic duct, outlined the common bile duct and appeared in the small intestine in five, ten and fifteen minutes respectively, after feeding. In a systematic study Whitaker<sup>18</sup> amplified these observations. In cats which had fasted for at least twenty-four hours, he replaced the content of the gall-bladder with iodized oil aseptically. The animals were then kept deprived of food for from sixteen to thirty hours and then fed egg-yolk. Roentgenologic observations proved that under these conditions, iodized oil appeared in the biliary ducts and the duodenum, while the shadow thrown by the content of the gall-bladder had decreased in size. Boyden,<sup>4</sup> working with the iodized oil method, observed that in cats a meal of egg-yolk, shaving of the leg of the animal, or incision of the skin, or transfusion of blood from fasting animals, caused a definite extrusion of oil from the gall-bladder; intravenous injection of barium chloride, pituitrin or cholin hydrochloride caused expulsion of iodized oil into the common duct. He also found that intravenous injection of adrenalin chloride (Parke-Davis)

twenty-four hours to operation, which consisted in drawing, by means of a syringe, a certain amount of bile from the gall-bladder and replacing it with the same amount of lipiodol, using ether anesthesia and aseptic technique. The animals were fasted after the operation until observations were to be made. With one exception there was no evidence of emptying of the gall-bladder during fasting, as a result of ordinary movements, or repeated firm external pressure over the area of the gall-bladder. Roentgenograms taken following vomiting or the act of defecation did not show emptying. Passage of a stomach tube, its manipulation and other maneuvers, as filling the stomach with air, and aspiration of the content, resulted in expulsion of material from the gall-bladder in a number of animals. A feeding of 300 to 500 c.c. of egg-yolk and cream mixture was usually followed within from ten to forty-five minutes by the passage of opaque substance from the gall-bladder through the cystic and common bile ducts into the duodenum.

Ivy and Oldberg (1928)<sup>11</sup> filled the gall-bladders of ten dogs with from 15 to 20 c.c. of lipiodol (after the same amount of bile had been withdrawn) under morphine-ether anesthesia and with aseptic technique. The animals received no food. From eighteen to twenty-four hours after the operation, a purified preparation of secretin (which they called cholecystokinin) was injected intravenously every ten minutes for one hour, and the effects studied on roentgenograms taken from two to ten minutes apart. These roentgenograms and subsequent necropsy findings showed that all but about 3 c.c. of lipiodol had been evacuated in three of the ten animals, about two-thirds in three, one-half in one, and a small amount in one.

Krause and Whitaker (1928)<sup>19</sup> used iodized oil to visualize the gall-



material in the biliary ducts and  
small intestine an hour later after the  
animal had taken a glass of milk.

Birch and Boyden (1930)<sup>2</sup> employed the  
iodized oil method in their recent study of  
the reactions of the cat's gall-bladder to  
faradic stimulation of the stomach, small  
intestine and cecum.

Crandall (1930)<sup>6</sup> filled the gall-bladders  
of five dogs with brominol-light and ob-  
served a partial spontaneous emptying of  
the viscus within five hours, even though  
the animals were given nothing by mouth.

As shown by the above brief review,  
Burckhardt and Müller were the pioneer  
workers in the field of cholecystography.  
Although they failed to develop the direct  
method for clinical use, they were the first  
to produce cholecystograms. The ambition  
of all the other investigators who applied  
the direct method, has been to visualize  
the gall-bladder in action. This review also  
enumerates the substances used for cho-  
lecystography and shows that lipiodol holds  
a popular place among them. Its high  
iodine content (about 40 per cent) makes  
lipiodol particularly useful in visualizing  
roentgenologically the course of ducts, bur-  
rowing sinuses, the position of cavities,  
etc. It is also an excellent medium for  
visualizing roentgenologically the depend-  
ent portion of the biliary vesicle. For the  
study of the finer mechanism of the gall-  
bladder, however, it is most unsuitable be-  
cause it does not mix with bile and both  
the specific gravity and viscosity are far  
greater than that of the ordinary content  
of the gall-bladder. Furthermore the shadow  
which it produces is too dense to per-  
mit observation of any detail. Two  
conclusions may justly be made of most  
experiments. In the first  
it is critically certain that replace-  
ment of the content of the gall-

In  
dol i  
limited  
turned after  
environment an  
ticable.

#### METHOD

Twenty-six normal healthy dogs were  
laparotomized: 2 c.c. of lipiodol was in-  
troduced into the gall-bladders of twenty,  
and brominol-light into six of the dogs  
after 3 c.c. of bile had been withdrawn.  
Following the operation the animals were  
replaced in their usual environment, were  
offered their usual diet, and an accurate  
record kept of their feeding. Roentgeno-  
grams were taken six hours after opera-  
tion and subsequently once daily until the  
shadow had vanished or remained station-  
ary for several days. In the latter case, a  
meal, consisting of raw chopped meat and  
two eggs, was fed, and a roentgenogram  
taken three hours later and one the follow-  
ing day.

#### EXPERIMENTS WITH LIPIODOL\*

According to the data charted in Table  
1, the shadow on the first films, i.e., six  
hours after the operation, averaged about  
3.5 by 1.5 cm. (more accurately 3.36 by  
1.75 cm.). The shadow disappeared com-  
pletely in three dogs by the end of the  
second day, in five dogs on the third and  
fourth days, in six between the fifth and  
tenth days and in one on the seventeenth  
day. In the remaining five dogs the shadow  
diminished to about 30 per cent of its  
original size, and remained nearly unal-  
tered until the experiment was concluded.

\* A brief summary of the results of these experiments was  
read (by title) at the Forty-sixth Session of the American Associ-  
ation of Anatomists.<sup>9</sup>



L-9 ♀ (9.5 kg.)			0 x 0	Ate regularly
L-1 ♂ (11 kg.)			0 x 0	Ate regularly
L-11 ♂ (5 kg.)			0 x 0	Ate regularly
L-18 ♂ (11 kg.)	26 x 15	3	0 x 0	Ate regularly
L-7 ♂ (10 kg.)	25 x 18	3	0 x 0	Ate regularly
L-2 ♀ (7 kg.)	48 x 16	4	0 x 0	Ate regularly
L-10 ♂ (8 kg.)	17 x 15	4	0 x 0	Ate regularly
L-15 ♂ (16 kg.)	45 x 16	5	0 x 0	Ate regularly
L-13 ♂ (11 kg.)	34 x 18	6	0 x 0	Ate irregularly
L-5 ♂ (12 kg.)	18 x 13	6	0 x 0	Ate irregularly
L-17 ♂ (15 kg.)	68 x 14	7	0 x 0	Ate irregularly
L-6 ♂ (22 kg.)	32 x 18	8	0 x 0	Ate irregularly
L-8 ♂ (5.6 kg.)	28 x 17	8	10 x 6	Ate regularly
L-20 ♂ (16 kg.)	26 x 20	10	0 x 0	Ate regularly
L-12 ♀ (10 kg.)	33 x 20	16	8 x 6	Ate regularly
L-19 ♂ (10 kg.)	30 x 17	17	0 x 0	Ate irregularly
L-4 ♂ (15 kg.)	37 x 20	22	21 x 7	Ate regularly
L-16 ♂ (15 kg.)	35 x 25	24	19 x 18	Ate regularly
L-14 ♂ (13 kg.)	45 x 26	26	18 x 12	Ate regularly

This occurred on the eighth day after operation in the case of one dog and from sixteen to twenty-six days in four other dogs.

At necropsy oil was recovered in the content of the gall-bladders of all of the five dogs in which the roentgen shadow persisted, but droplets of oil were found also in the gall-bladders of some of those dogs in which the shadow had disappeared.

#### EXPERIMENTS WITH BROMINOL-LIGHT

According to the data charted in Table II, the shadow on the first films, i.e., six hours after the operation, averaged about 2.8 by 2.1 cm. (more accurately 2.73 by 2.15 cm.). The shadow disappeared completely in two dogs by the end of the second, in two by the end of the fourth, and in one on the sixth day after the operation. One dog which refused food retained the shadow almost

unaltered for seven days, at the end of which time she died.

At necropsy droplets of oil were found in the content of the gall-bladder in most of these dogs.

#### COMMENT

Both lipiodol and brominol-light sink to the bottom when mixed in vitro with bile. No tendency to go into solution was observed in mixtures that were allowed to stand for fourteen days at room temperature. The viscosity of lipiodol is 90 compared with water, while that of bile from the gall-bladder averages about 2, of brominol-light 5 (Crandall).<sup>6</sup> Their physical properties both of lipiodol and brominol-light when introduced into the gall-bladder seek a position in the viscous bile. In fact it was in experiments from the gall-bladder



task for the gall-bladder than  
tion of brominol-light. In fact, f  
disappearance of the shadow of lipi  
dol three to eight days were necessar  
ten of the twenty dogs, and ten to seven-  
teen days in two. In 25 per cent of the  
dogs the shadow diminished to about 30  
per cent of its original size and remained  
nearly unaltered from eight to twenty-

rams en six  
tion and s. osequent' once daily  
shadow had vanished or rem  
tionary for several days. In  
case, a meal, consisting of raw  
meat and two eggs, was fed, and :

TABLE II  
EXPERIMENTS WITH BROMINOL-LIGHT

Dog	Size of shadow of gall-bladder content (in mm.)			Feeding record
	Six hours after operation	Duration of experiment in days	At end of the experiment	
B-2 ♀ (12 kg.)	28 x 21	2	0 x 0	Ate regularly
B-4 ♀ (11 kg.)	28 x 20	2	0 x 0	Ate regularly
B-3 ♀ (10 kg.)	31 x 30	4	0 x 0	Ate regularly
B-6 ♂ (8 kg.)	26 x 23	4	0 x 0	Ate regularly
B-1 ♂ (15 kg.)	28 x 15	6	0 x 0	Ate regularly
B-5 ♀ (10 kg.)	23 x 20	7	22 x 20	Refused food.

six days, in spite of several feedings with chopped meat and eggs. Brominol-light, on the other hand, was eliminated by the fourth day in four of the six dogs.

experiments with methylene blue it w  
turned that a more or less complete  
exch of the content of the gall-bladder  
usually occurs in the dog within about  
wen four hours.<sup>14</sup> From the above ex-  
perim ents it seems probable that a com-  
plete vacuation of the biliary vesicle never  
takes place in the dog. It is reasonable to  
that the exit of lipiodol and bro-  
at occurs spontaneously when the  
the cystic duct happens to be the  
In those dogs in which,  
or other, this does not  
iodol remains in the gall-  
almost indefinitely.

genogram taken three hours later and one the following day.

In the experiments with lipiodol, the shadows on the first films averaged about 3.5 by 1.5 cm. The shadow disappeared completely in three dogs by the end of the second day, in five dogs on the third and fourth days, in six between the fifth and tenth days, and in one on the seventeenth day. In the remaining five dogs the shadow diminished to about 30 per cent of its original size and remained nearly unaltered until the experiment was concluded, i.e., eight to twenty-six days after operation.

In the experiments with brominol-light, the shadows on the first films averaged about 2.8 by 2.1 cm. The shadow disap-  
peared completely by the fourth day in four of the six dogs.



# REFERENCES

1. ABRAMSON, HAROLD A. Visualization of the gall bladder of the dog by the Roentgen ray. *Proc. Soc. Exper. Biol. & Med.*, 1923-1924, 21, 407-409.
2. BURCH, CARROLL L., and BOYDEN, EDWARD A. Reaction of gall bladder to stimulation of gastrointestinal tract. *Am. J. Physiol.*, 1930, 92, 301-316.
3. BOYDEN, EDWARD A. The effect of natural foods on the distention of the gall bladder, with a note on the change in pattern of the mucosa as it passes from distention to collapse. *Anat. Rec.*, 1925, 30, 333-363.
4. BOYDEN, EDWARD A. A study of the behavior of the human gall bladder in response to the ingestion of food; together with some observations on the mechanism of the expulsion of bile in experimental animals. *Anat. Rec.*, 1926, 33, 201-255.
5. BURCKHARDT, H., and MÜLLER, WALTHER. Versuche über die Funktion der Gallenblase und ihre Röntgendarstellung. *Deutsche Ztschr. f. Chir.*, 1921, 162, 167-197.
6. CRANDALL, LATHAN A. A study of possible mechanisms for gall bladder contraction and evacuation. *Am. J. Physiol.*, 1930, 93, 642.
7. GRAHAM, E. A., and COLE, W. H. Roentgenologic examination of the gall-bladder, new method of utilizing intravenous injection of tetrabromphenolphthalein. *J. Am. M. Ass.*, 1924, 82, 613-614.
8. GRAHAM, E. A., COLE, W. H., COPHER, G. H., and MOORE, SHERWOOD. Diseases of the Gall Bladder and Bile Ducts. Lea and Febiger, Philadelphia, 1928.
9. HALPERT, BÉLA, and REWBIDGE, ALLAN G. Roentgenological studies on the gall bladder of the dog. Experiments with lipiodol. *Anat. Rec.*, 1930, 45, 262.
10. HAMRICK, ROBERT A. The emptying of the gall bladder; an experimental study. *Am. J. M. Sc.*, 1927, 174, 168-181.
11. IVY, A. C., and OLDBERG, ERIC. A hormone mechanism for gall-bladder contraction and evacuation. *Am. J. Physiol.*, 1928, 86, 599-613.
12. KRAUSE, WILLIAM F., and WHITAKER, LESTER R. Effects of different food substances upon emptying of the gall-bladder. *Am. J. Physiol.*, 1928, 87, 172-179.
13. POTTER, J. C., and MANN, F. C. Pressure changes in the biliary tract. *Am. J. M. Sc.*, 1926, 171, 202-217.
14. REWBIDGE, ALLAN G., HANKE, MILTON T., and HALPERT, BÉLA. Further observations on the function of the gall bladder. Experiments with methylene blue on the dog. *Am. J. Physiol.*, 1930, 95, 511-518.
15. VALDONI, PIETRO. Studi sul potere di assorbimento della cistifellea normale e patologicamente alterata. *Policlinico (sez. chir.)*, 1930, 37, 8-32.
16. WHITAKER, L. R. Experiences with cholecystography, including observations on the function of the gallbladder. *J. Am. M. Ass.*, 1925, 36, 239-243.
17. WHITAKER, L. R., and BOYDEN, E. A. Observations on the function of the gall bladder. *Am. J. Physiol.*, 1926, 76, 199.
18. WHITAKER, L. R. The mechanism of the gall bladder. *Am. J. Physiol.*, 1926, 78, 1-436.



was protected by...  
The lead bars were held in place by...  
...ing them in a block of paraffin...  
...5 × 95 mm., as shown in Memorial...  
A portion of one corner of the block was cut away to allow for the placement of the body.

The steps in the procedure incident to irradiating the tail are as follows. The mouse was placed on its back on a lead shield 55 × 55 mm. and 7 mm. thick, and was held in place by sling-like fastenings of adhesive strips which passed around its body and held it firmly to the lead block with its tail protruding from one edge (see "F", Fig. 3). The mouse was adjusted so that the movement of the tail in an anteroposterior direction was reduced to a negligible quantity, and still the animal was not restricted in its breathing and remained in place without discomfort. The tail was then "threaded" into the two lead bars described above, and the shield holding the mouse was placed on the three rubber pillars (sections of rubber stoppers cut to the proper height). Proper alignment of the lead shield on which the mouse was fixed and the lead bars into which the tail fitted was effected by a notch in the smaller lead bar which fitted into a similar notch in the lead shield cut just below the portion which shielded the proximal region of the tail. At this step in the procedure an extra block of lead was placed on the shield to still further protect the tail. The block had the same surface dimensions as the one on which the body was held, but was 13 mm. thick. The body was thus protected by 20 mm. of lead. The procedure has now been illustrated in Figure 2.

...was to cover the exposed tail, which was so placed...  
...l surface was uppermost, ...  
...block of paraffin which fitted

...o time...  
...tended to...  
The source of radiation... mammalian,  
above the small paraffin...  
roentgen rays were used, the thickness of paraffin above the dorsal surface of the portion of the tail irradiated was 2.5 mm.

The irradiated tail segment was thus surrounded above, below (a groove was cut in the paraffin at its ventral surface similar to the one at the dorsal surface) and to the sides by paraffin, which it was expected would give a "scattering" effect in addition to the primary radiation which reached the tail. This scattering effect might be expected to simulate the scattering produced in tissues when treated by radiation. No attempt was made to prevent secondary radiation, from the ends of the lead bars, etc., from reaching the irradiated segment of the tail. However, this factor remained constant.

After the tail was irradiated, the small paraffin block was removed and a small mark of red ink was placed on that portion of the tail which was directly below the center of the source of radiation. The animal was then removed and the length of the tail recorded, from tip to anal margin.

The diameter of the tail at the red mark was also recorded, as well as the distance of the red mark to the tip of the tail. The mouse was given a catalog number which corresponded to identification marks cut in one or both ears, and it was returned to its nest cage.

#### GROSS ANATOMICAL CONSIDERATIONS

The tail of a young mouse is covered with soft, short hairs evenly distributed over



pos. of this p. to be-  
scr. necropsy method. the  
light we fairly well. the  
bladder in its use, to g  
reactions th  
lines.

and

vert

The

flat

in the experimental

to be measured and

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

the

what takes place when a tail segment, 5 mm. in length, is irradiated following the preliminary technique described above. If a so-called silver tube containing radon is to be used at a desired distance of 3.50 mm. from the dorsal surface of the tail, the distance is calculated from the center of the cross-section diameter of the silver tube, which is approximately at the center of the source of radiation. The thickness of the paraffin block above the tail segment would then be 2.5 mm. (0.5 mm. for one-half the internal diameter of the silver tube plus 0.5 mm. for the wall thickness, plus 2.5 mm. of paraffin, equals 3.50 mm.).

The silver tube is 16 mm. long. Its midpoint is placed on the small paraffin block directly over the center of the tail segment and at right angles to the long axis of the tail.

In the experiment about to be described silver radon tubes were used, the initial strength of which varied from 116 to 130 mc. when they were applied to a series of eight tails. The distance was 3.5 mm. and the doses varied from 10 to 250 millicurie-hours. The tails were examined each day after the treatment. Doses of 10 and 20 mc-hr. respectively resulted in no appreciable reaction up to twenty-five days when the animals were killed and the tails removed for photographing (see Nos. 11 and 10 of Fig. 4 respectively).

With a dose of 40 mc-hr. the initial reaction was a slight desquamation of the skin over the dorsal portion of the irradiated

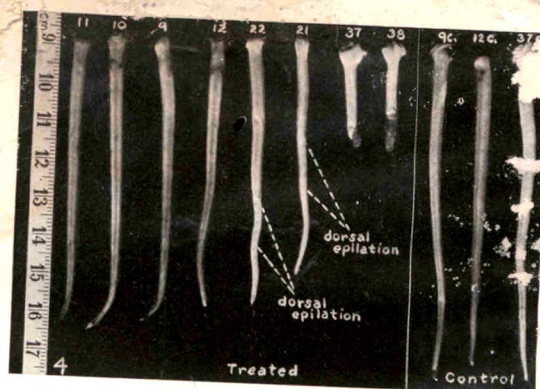


FIG. 4. Eight irradiated tails and three controls are here shown. They were removed from the respective animals twenty-five days post treatment. Treatments: 10 to 250 mc-hr. respectively; filtration 0.5 mm. silver; distance 3.25 mm.; 116 to 130 mc. of radon used. Animal No. 11 = 10 mc-hr.; No. 10 = 20 mc-hr.; No. 9 = 40 mc-hr.; Nos. 12 and 22 = 63 mc-hr. each; No. 21 = 80 mc-hr.; No. 37 = 100 mc-hr.; No. 38 = 250 mc-hr.; 9c and 12c are tails of control animals, litter mates of animals 9 to 12 inclusive, killed when the same age; 37c is a similar control for No. 37.

A dose of 63 mc-hr. was given to each of two animals, and 80 mc-hr. to another. In each instance the initial reaction was a slight dorsal epilation, noted nine days post treatment. This became more pronounced and resulted in a complete epilation of the dorsal surface of the irradiated tail segment. The tails of these three animals are shown in Nos. 12, 22 and 21 of Figure 4. Note the progressive increase in tail length with increasing doses. The epilated areas show fairly well in Nos. 22 and 21.

A much more pronounced reaction follows as a result of an irradiation of 100 mc-hr., as shown in animal, No. 37 of Figure 4. In this case, the reaction, desquamation and epilation of the irradiated segment, was



gives essential, just recorded, noted one day sooner and spontaneous amputation likewise occurred a day earlier, on the seventeenth day post treatment (see No. 38, Fig. 4).

Let us again consider the tissue reactions that result from placing the so-called bulb applicator directly on the surface of a segment of the mouse's tail. The glass bulb in which the radon is confined is shown at "H" of Figure 3. The steel holder in which the bulb is placed is illustrated at "I". The glass bulbs average approximately 3.5 mm. in outside diameter; so the center of the source of radiation is at approximately 1.75 mm. from the dorsal surface of the tail. The bulb touches the dorsal surface at one place very lightly. As no metal filters are used, the type of tissue reaction that results is mainly due to beta radiation.

In the experiment about to be described radon bulbs were used, the initial strength of which varied from approximately 5 to over 500 mc.<sup>1</sup> when they were applied to a series of 51 tails. The doses varied from 5 to 404 mc-min. Doses of 5 and 5.5 and 25 mc-min. respectively gave no apparent reaction. One dose of 30 mc-min. resulted in a temporary epilation, mainly of the dorsal surface of the tail. The center of the epilated area was immediately adjacent to the point of application of the radon bulb. For a graphic representation of this experiment see Figure 5, also Table 1.

A dose of 50 mc-min. is apparently close to the threshold dosage between temporary and permanent dorsal epilation. We have apparently reached a plateau on what be called the reaction curve, as Figure 5. Doses from 50 to give approximately the same reaction, permanent dorsal epilation,

On thirty seven days post treatment, the observations terminated. The uniformity in reaction was surprisingly regular. Given the tails of the experimental series, indicator, distance factor, etc., from an examination of the tails alone that the treatments had ranged over a definite span of the reaction curve.

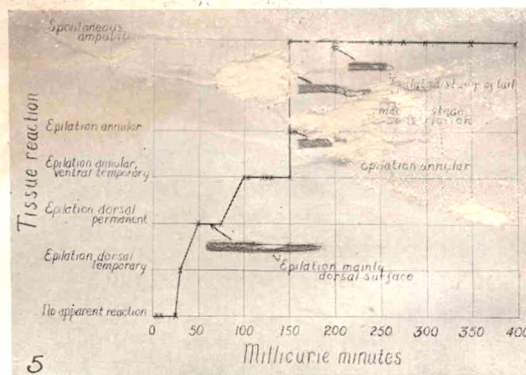


FIG. 5. This is a graphic presentation of the tissue reactions to radiation as shown in an irradiated segment of the tail of a young mouse. Applicator used—radon bulb directly on dorsal surface of a 5 mm. segment of the tail. No filter used. X. Dosages tested; for number of animals in each group, see Table 1. The sketches show typical reactions of the tails for various locations on the curve.

Doses between 50 and 75 mc-min. do not sufficiently irradiate the tail to cause an epilation of the ventral surface of the treated segment. A sketch of the side view of this tail reaction is shown in the lower drawing in Figure 5. This type of reaction is to be expected, because the tissue response resulted largely from beta-ray radiation, which was mainly employed in this particular experiment. Quimby<sup>1</sup> has shown that approximately 84 per cent of the beta-ray activity is absorbed by 2 mm. of tissue. Also as the source of radiation was close to the dorsal surface of the tail, even the slight difference in distance of the dorsal and ventral tail surfaces respectively from the center of the source of radiation, resulted in the ventral surface receiving less effective irradiation than the dorsal surface.



Summary showing the effect of the dosage in mc-min. and the tissue reaction following the mainly beta-ray radiation from a source placed directly on the segment of the tail of a young rabbit.

Number of Animals	Dosage mc-min.	Tissue Reaction
1	5.0	No apparent reaction.
2	5.5	No apparent reaction.
3	25.0	No apparent reaction.
4	25.0	No apparent reaction.
5	30.0	Temporary dorsal epilation.
6	30.0	Permanent dorsal epilation.
7	50.0	Permanent dorsal epilation.
8	50.0	Permanent dorsal epilation.
9	50.0	Permanent dorsal epilation.
10	50.0	Permanent dorsal epilation.
11	75.0	Permanent dorsal epilation.
12	75.0	Permanent dorsal epilation.
13	75.0	Permanent dorsal epilation.
14	75.0	Permanent dorsal epilation.
15	100.0	Annular epilation, ventral-temporary.
16	100.0	Annular epilation, ventral-temporary.
17	100.0	Annular epilation, ventral-temporary.
18	100.0	Annular epilation, ventral-temporary.
19	102.0	Annular epilation, ventral-temporary.
20	121.0	Annular epilation, ventral-temporary.
21	125.0	Annular epilation, ventral-temporary.
22	130.0	Annular epilation, ventral-temporary.
23	150.0	Annular epilation, ventral-temporary.
24	150.0	Annular epilation, ventral-temporary.
25	150.0	Annular epilation, ventral-temporary.
26	150.0	Annular epilation, ventral-temporary.
27	150.0	Annular epilation, ventral-temporary.
28	150.0	Annular epilation, ventral-temporary.
29	150.0	Annular epilation, ventral-temporary.
30	150.0	Annular epilation, ventral-temporary.
31	150.0	Permanent annular epilation.
32	150.0	Permanent annular epilation.
33	150.0	Permanent annular epilation.
34	150.0	Permanent annular epilation.
35	150.0	Permanent annular epilation.
36	150.0	Permanent annular epilation.
37	150.0	Permanent annular epilation.
38	150.0	Spontaneous amputation.
39	150.0	Spontaneous amputation.
40	200.0	Spontaneous amputation.
41	200.0	Spontaneous amputation.
42	240.0	Spontaneous amputation.
43	240.0	Spontaneous amputation.
44	250.0	Spontaneous amputation.
45	260.0	Spontaneous amputation.
46	275.0	Spontaneous amputation.
47	300.0	Spontaneous amputation.
48	300.0	Spontaneous amputation.
49	350.0	Spontaneous amputation.
50	404.0	Spontaneous amputation.
51	404.0	Spontaneous amputation.

<sup>1</sup> It is interesting that this wide range of intensities gives apparently essentially similar reactions. We are studying this phase of the problem in greater detail with an additional number of observations. There are too few observations at the lower dosages at the present time. When still more data are obtained at the critical threshold dosages it is possible that intensity differences may be found to modify the results.

This tissue reaction is specified in Table 5 as "annular epilation with temporary epilation of the ventral surface."

The dose of 150 mc-min. represents a critical point in the reaction curve of this particular experiment. Eight tails treated with this dose showed temporary annular epilation on the ventral surface. Seven other tails treated with the same dosage showed complete, permanent, annular epilation. This tissue reaction marks another point on the reaction curve. Two other tails were still more severely affected by this same dosage and were spontaneously amputated fifteen and twenty-four days post treatment respectively.

In the 12 instances tested, doses of 200 mc-min. and over invariably resulted in the spontaneous amputation of the tail at the irradiated segment.

#### SUMMARY OF CHANGES THAT OCCUR AS A RESULT OF EXPOSURE TO VARIOUS TYPES OF RADIATION

The following reactions are given in sequence of time of appearance after treatment, but they do not necessarily all appear after every exposure:

1. Erythema: Occasionally noted in gamma and roentgen radiation, but four times as an initial reaction to strong beta radiation.
2. Slight dorsal epilation of tail segment.
3. Slight epilation all surfaces of tail segment.
4. Epilation and desquamation of ventral surface.
5. Ulceration.
6. Temporary epilation: This usually follows moderate gamma radiation.
7. Permanent epilation.
  - (a) Dorsal only.
  - (b) All surfaces.



Constriction of ta  
an' epilation.

v gangrene of  
tal end.

pecus amputation of tail.

F A GRADUO BIOLO

IN TERMINING N

SELY THE REACTIO

THRESHOLD

us that the reaction of t

mean of a young mouse as recorded in this paper, affords a fairly accurate guide in estimating the biological response to irradiation, and it certainly is a type of indicator more nearly applicable to comparison with clinical studies of this nature. The divisions on the scale, as it were, are more finely divided.

It is possible to deliver a dose, by the methods we have employed, that will produce an epilation of just the dorsal surface of the tail, or if a stronger and more heavily filtered dose is given, an epilation effect which covers the entire irradiated segment. There is a plateau in the reaction curve which corresponds to a range of doses which will produce either one of the types of reaction just mentioned. One can use dosages as experimental measures at either end of this plateau.

At the end of the plateau representing the reaction to the stronger dosages a slight increase in the dose will lead from an epilation reaction to a spontaneous amputation of the tail. There is apparently a critical threshold point where the tissues of the tail can tolerate no further increase in dosage, and this probably is correlated with a breakdown in the circulatory sup-

experiments we have just recorded  
merely to illustrate the general  
of the new biological measure  
ing in this type of study. We  
the method well adapted to an  
study of the effect of varying  
the filtration, intensity of ir-  
rardium from radium or roentgen  
the Thirty the experiments are still

# THE LEUCEMIAS AND THE RING ON

however [2/5] for Medical

OR, MIC

tail, or in the spontaneous action.

## REFERENCE

- I. QUIMBY, E. H. Comparison of different filters used in radium therapy. AM. J. ROENTGENOL. & RAD. THERAPY, 1925, 13, 330-342.

## DISCUSSION

DR. H. J. ULLMANN, Santa Barbara, Calif. This paper covers, as Dr. Bagg said, quite a large field. I hope that he will correlate these reactions with the human skin erythema dose of radium and also with the roentgen-ray skin dose, thus making the method clinically useful. Dr. Bagg spoke of extending the exposure over a period of two weeks. This would hardly parallel clinical practice, for it would be practically equivalent to ten months on man. One hour on a mouse is equivalent to from twenty to twenty-five hours on a human being. I think this should be taken into consideration, and I wish to ask Dr. Bagg whether they have considered it or are going to do so.

DR. W. S. NEWCOMET, Philadelphia. This paper is interesting to me because last year I saw a child who had been irradiated for sarcoma of the hip at the age of about three or four. She is now about seventeen and one side of her pelvis and one leg shows a growth of four or five years, while the other side of the leg and the remaining portion of the pelvis shows normal development.

This paper is also interesting in connection with angioma. I have seen a number of cases that were treated and have seen the patients afterward. These children are treated at an early age and the pictures show splendid results a year or so afterward. The lips seem well balanced and in good condition at that time, but I have seen two patients after they had reached the age of seventeen or eighteen and



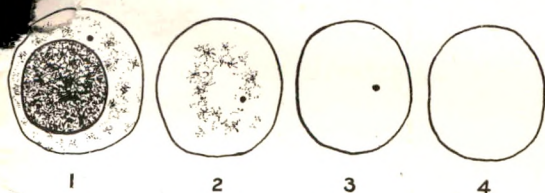


FIG. 2. Stages in the development of the red blood cell. 1. Nucleated cell (normoblast). 2. Reticulocyte. 3. Granule cell. 4. Mature cell.

(Fig. 2). Immediately (less than  $\frac{1}{2}$  hour) after adequate roentgen therapy the number of granule red blood cells increases, showing that reticulocytes have been

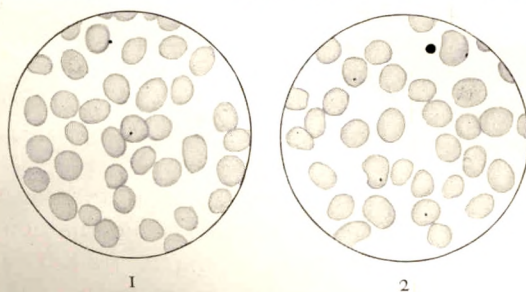


FIG. 3. Red blood cells before and immediately after irradiation in a patient with lymphoblastoma. The first field shows one granule red blood cell. The second field shows the increase in the number of granule red blood cells.

matured to the next older stage (Fig. 3). Then the reticulocytes increase, showing that the nucleated cells have been stimulated to mature rapidly to the reticulocyte

stage and are not apoptotic, and was a novel effect. One could then predict that the therapy would be effective.<sup>5</sup> This is well shown by a study of patients with cancer, leucemia and lymphoblastoma, as well as the ability to induce a remission in pernicious anemia or improvement in other anemias with roentgen irradiation (Minot and Lee,<sup>13</sup> and others).<sup>1,3,4,19,20</sup> Pernicious anemia is characterized by gross immaturity of the red blood cells in the bone marrow, and the stimulus of the roentgen ray makes the cells mature. (The ease of production of a remission, however, with liver or dried stomach, makes the use of the roentgen ray, as a therapeutic measure in this disease, uneconomical and primarily of academic interest at present.)

#### LYMPHOCYTES

Similar evidence may be gathered from a study of the lymphocytes. The youngest stage reaching the peripheral circulation under pathologic conditions is the primitive lymphoblast (Fig. 4), which resembles the primitive myeloblast closely in its appearance and its behavior to roentgen irradiation. The cell normally is confined to the lymphoid tissue and during its life matures into the lymphoblast, then the large lymphocyte, then the medium sized and finally the adult small lymphocyte (Fig. 4). Exposure to roentgen irradiation during the primitive lymphoblast stages, causes the production of additional primitive lymphoblasts. The bulk of the cells are in this stage in lymphatic leucemia and in the early stages of chronic lymphocytic leukemia.



PRIMITIVE LYMPHOBLAST LARGE LYMPHOCYTE  
 LYMPHOBLAST LYMPHOCYTE  
 RED BLOOD CELL

FIG. 4. Stages in the development of the lymphocyte. Drawn on the same scale, from the blood of a patient with chronic lymphatic leucemia. A red blood cell is shown to indicate the relative sizes.

creted into the gastrointestinal tract (Isaacs and Danielian,<sup>6</sup> Bunting and Huston<sup>2</sup>). Therefore, the quickest response in reduction of the white blood cell count after adequate therapy comes when the bulk of the cells are small and medium sized (*i.e.*, relatively mature) lymphocytes, and the response is but slight when the bulk of the cells are large lymphocytes and lymphoblasts. The stimulation of young stages to grow older results in an initial increase in the number of lymphocytes in the blood stream before the decrease starts. This is best seen when very small doses have been used.<sup>17,18</sup>

The monocytes, especially as seen in monocytic leucemia go through a similar process of stimulation and development although at a much slower rate.

#### FREQUENCY OF TREATMENT

It is thus evident that every exposure of a patient to roentgen radiation stimulates the "blast" cells to reproduce and the mature cells to become senile and finish their life cycle in a normal and orderly manner. However, a death by acute necrosis when therapeutic doses are used. If treatments are separated by an interval long enough for the dividing cells grow and divide when the next maximum dose is

applied to the rays as few times as possible, as every additional exposure increases the growth of the "blast" cells and hastens the time which every patient reaches, in which he no longer "responds" to the therapy.

There is always a *latent period* between the time of exposure to the radiation and the therapeutic results. This period represents the length of time that it takes for a cell to mature and behave as an adult tissue, and suffer its fate. It varies with the kind of cell, and the stage of development at the time of irradiation (reticulocyte to granule red blood cell, 15 minutes; myelocyte to metamyelocyte about  $3\frac{1}{4}$  hours; carcinoma of the breast cell, around two weeks; etc.) as well as with the effective dose.

Adequate radiation therapy produces great symptomatic improvement, but on the average does not prolong the life of the irradiated group as compared to a similar but non-irradiated group (Minot, Buckman and Isaacs,<sup>9</sup> Minot and Isaacs<sup>10</sup>). Of course individual patients are encountered whose life is actually prolonged by the emergency use of irradiation in removing an immediate and mechanical cause of death, *e.g.*, enlarged tissue mass. The same condition is true in the value of lymphoblastomas (Minot and Isaacs<sup>10</sup>).

to the process, and only when there is great reduction of the size of a gland. If the lymphocytes, however, are removed by roentgen rays, the gland will be smaller, but the process is allowed to proceed by itself, as in the latter case there is the continued fibroblastic proliferation while the disease takes its normal course.

In lymphosarcoma the predominant cell in the glands is a lymphoid cell, probably not one of the normal stages of the lymphocyte, however. It seldom gets into the peripheral circulation in appreciable numbers, though in some cases there is a moderate increase in the number of lymphocytes. The lymphosarcoma cell itself appears to be quite susceptible to irradiation, and its changes must not be confused with those of the normal blood cells or their precursors.

A roentgen ray, or relieving anemia in the presence of foreign cells, and allow blood corpuscles to mature. If the gland cells are myeloblasts or lymphoblasts, roentgen irradiation will not clear out the tissue; the prognosis is bad and anemia will not be improved. In lymphatic leucemia if the hemoglobin cannot be raised above 50 per cent after adequate radiation therapy, the prognosis is bad and little symptomatic improvement can be expected.<sup>10</sup> Thus, it is not the anemia or the low hemoglobin which makes the treatment ineffective, but the underlying cause. Furthermore, anemia may not necessarily contraindicate treatment, but, as in chronic myelogenous leucemia, actually be an indication calling for roentgen therapy.

#### BLOOD PLATELETS

The same condition exactly characterizes reduction in the number of blood platelets. Reduction in number means, in the leucemias, crowding out of the platelet-forming cells (megakaryocytes). If the crowding tissue cannot be cleared away by roentgen therapy, the platelet number cannot be increased and at the same time the immobility of the foreign tissue means that roentgen therapy is futile and the prognosis is bad. However, if the foreign tissue can be cleared away, the patient will of course be improved and secondarily the platelet number will be increased because of increased space to grow. The platelets are frequently reduced in lymphatic leucemia and always in lymphoblastic and myeloblastic leucemia. They are greatly increased in chronic myeloge-

#### DATA MODIFYING TREATMENT

The number of red or white blood cells alone is not a guide to treatment. The numerical data must be considered in connection with the condition of the patient, the size and position of enlarged glands, the subjective symptoms, the basal metabolic rate and associated signs, the basal metabolic rate, with nervous sweating, fast pulse and loss of weight. These are definite indications for treatment though the leucocyte count is not markedly elevated. In the absence of these signs, in spite of a high white blood count, the treatment may be postponed. It must be remembered that a low leucocyte count may mean lack of production of the cells. This means its life cycle.

As to the actual dosage, in general it may be said that the larger the effective dose given at one time (*i.e.* within the space of two to four days), the quicker is the response on the part of the blood cells. There is an intermediate dosage between large and small which frequently is not very effective in inducing blood changes.<sup>8</sup> The small doses frequently produce the changes so slowly that many developments can be noted which may be overlooked after large doses because of their shortened duration and rapid sequence. It is wise to divide the maximum possible dose into several days' treatment so that when the proper changes in the type of blood cells are produced (not necessarily the change in the blood count) the treatments may be suspended. From the point of view of the blood cells, treatments given within four days have much the same effect as if given all at once. If a week or more elapses, the effect is that of a second treatment. For all practical purposes, roentgen rays, radon and the radio-

creted. The rapid excretion of the leucocytes represents maturation and development of individual cells to senility. The cells are excreted into the gastrointestinal tract (polymorphonuclear cells into the mouth, lymphocytes into the intestines). Very rapid excretion may result in a decrease in the number of cells in the peripheral circulation (leucopenia), giving the false impression of an aplastic bone marrow. Anemia may mean crowding out of red blood cell tissue by foreign cells, or it may mean actual aplasia of the bone marrow. Anemia, then, as well as leucopenia, may not necessarily be a contraindication to roentgen therapy. As the peripheral blood count does not always give a clue as to the state of the blood-forming organs, several other factors must be taken into account in considering treatment (rate of cell destruction, type of the cells, basal metabolic rate and associated symptoms and previous response to roentgen irradiation).

#### REFERENCES

1. KY, G., and GUGGENHEIMER, H. Steigerung Knochenmarksfunktion durch Röntgenstrahlen. *Klin. Wchnschr.*, 1922, 1, 11-12.
2. MINTING, C. H., and HUSTON, J. Fate of the leucocyte. *J. Exper. M.*, 1921, 33, 593.
3. A. Morphological changes of the blood, following irradiation of the splenic area, with stimulating doses. *Radiol. med.*, 1927, 11, 529-558.
4. M. A case of severe anemia of aplastic type treated with radiotherapy. *Policlinico, sez. prat.*, 1229-1232.
5. Effect of roentgen ray irradiation on blood cell production in cancer and in chronic myeloid leukemia. *Am. J. M. Sc.*, 1926, 171, 20-37.
6. ISAACS, R., and DANIELIAN, A. C. Maintenance of leukocyte level and changes during irradiation; a study of the white blood corpuscles appearing in the saliva and their relation to those in the blood. *Am. J. M. Sc.*, 1927, 174, 70-87.
7. KENNEDY, W. P., and GROVER, C. A. Studies on the Armet count. VIII. The deflection of the count by x-rays. *Quart. J. Exper. Physiol.*, 1927, 18, 79-87.
8. LOEB, L. The effects of roentgen rays and radioactive substances on living cells and tissues. *J. Cancer Research*, 1922, 7, 280-282.
9. MINOT, G. R., BUCHANAN, J. W., and ISAACS, R. Chronic myeloid leukemia. Its incidence,



18. R., and LEE, R. I. Treatment of pernicious anemia, especially by transfusion and splenectomy. *Boston M. & S. J.*, 1917, 177, 761.
19. THOMAS, M. M., TAYLOR, F. D., and BEE, W. D. Studies on the stimulative action of the thyroid gland. *Exper. M.*, 1919, 29, 75.
20. TOMÁNEK, F. Results of radium treatment of pernicious anemia. *Casop. lékař. česk.*, 1924, 63, 549-552.
21. YOUSSEF, A. Roentgen therapy in blood diseases. *Vestnik. roentgen. i radiol.*, 1924, 3, 18.

Dr. W. E. CHAMBERLAIN, San Francisco.  
Dr. Isaacs speaks with more assurance than I can bring to bear upon this problem. I feel doubtful upon practically every point concerning which he speaks rather dogmatically. I sometimes think that the study of the blood does not even help in prognosis, although in general, blood studies do help in giving a prognosis. They have not helped me very much in carrying on my treatment. Some years ago I became enthusiastic about very small doses, and today my rule in the treatment of these cases is to get along with as tiny doses as I possibly can get results with. I also prefer to treat them with as little frequency as possible, that is, I would rather treat them once a month than once a week or daily. But I often have to give the treatments at frequent intervals in order to keep the dose very small. A few days ago I had a case which did not respond to the small doses and I reluctantly changed to a large dose over the spleen, and immediately got a response, not just in the blood picture but in the clinical wellbeing of the patient. That has happened a number of times and perhaps is one of the reasons why I do not feel sure about any part of this problem of treating the leucemias and the lymphomata. It is often necessary to individualize the treatment. You must at least expect it; it is necessary to use a technique from a small

DR. H. K. PANCOAST, Philadelphia. I wish to retract a statement made this afternoon. I said there had been no advances in the treatment of the leucemias since the early cases treated back in 1902 and 1903, with a few exceptions. The advances that we have been hoping for are those which you have just mentioned about. We have realized that it is the lysis of blood that we would like to have for changing our technique which might give us better results. I feel sure we have had many reasons for making changes in our treatment of different cases. It is not only in the treatment of the leucemias but in other diseases of this type, we must have full cooperation of the pathologist.

whether it is seen or follows until they do not respond to radiation. As we all know, they reach a stage. At that stage, does the change explain the lack of roentgen response?

G. E. PFAHLER, Philadelphia. I would like to ask Dr. Isaacs what the dosage has been in these instances in which he saw a stimulation of the development of the various cells and before this stimulation proved to be in these cells. It is new in our experience and in the various experimental records of all kinds of tissues and all kinds of living substances that have been treated. We do not get in other things a stimulating effect, a true stimulating effect. I am anxious to know what this evidence has been and how it has been proved.

DR. ISAACS (closing). A number of puzzling points have been brought up. Evidently this subject is one full of controversy. Why should small doses sometimes cure and large doses make worse? It depends on the predominant stage of the cells in the bone marrow or the lymph nodes, not on the predominant stage in the blood stream. Sometimes in Hodgkin's disease or lymphosarcoma it is impossible to get from the blood stream the condition in the marrow. Therefore we must use other things such as basal metabolic rate, the pulse rate, the weight, the patient's general well-being.

The method of counting the cells in the saliva is simple. The patient is told to clear his mouth by swallowing all the saliva

that is in his mouth. The slides are then made. There are about a millimeter of saliva in the mouth. After treatment which stimulates the mature cells come into the saliva. If you make very careful counts of the stages of the blood cells and the red blood cells after roentgen treatment, it will be seen that the first stage is an increase in the number of mature cells or more mature cells than the blood stream showed. Immediately after roentgen treatment there may be an increase in the number of myelocytes for a few hours on the first day after treatment, a few myeloblasts having matured. Many polymorphonuclears have matured from the myelocytes. In other words, you can actually count the cells and study the process of cells getting more mature. You do not kill cells with roentgen rays; you give the treatment and then wait for results. This period in the blood corresponds to the length of time for the predominant cells to mature. Many a patient has been treated a long time and failed to respond. In that case the cells are mostly in the stage of lymphoblasts or myeloblasts.

DR. F. B. STEPHENSON, Denver, Colo. Do we understand that roentgen treatment of a normal person will cause the same increase of cells in the saliva?

DR. ISAACS. I haven't treated a normal person. In patients with cancer or some small growths elsewhere in the body, the effect is exactly the same. Any condition which stimulates cells to get ripe, will cause an increase in the number of cells in the saliva.



fact that ma-  
 such as Mueller, Schlesinger,  
 Lee and Herendeen, Le-  
 anenbaum, and Buday, found  
 the al column involved most fre-  
 quently, then the pelvis, then the upper  
 part of the arm, then the ribs, and then the  
 skull. Occasionally a primary tumor had  
 not been found clinically, and yet symp-  
 toms of metastasis were manifest. Other  
 authors, such as Helly, Risley, Matthews,  
 Ritchie and Stewart, and Belot and Lepen-  
 netier, stated that the possibility of metas-  
 tasis stands in close relationship to the  
 histologic structure and spatial extent of the  
 primary tumor; that the greater its local  
 growth, the less likely it is to metastasize,  
 and that the greatest incidence of metas-  
 tasis to bone is noted in scirrhous car-  
 cinoma.

#### MECHANISM OF METASTASIS

The mechanism by which malignant cells  
 carried to the vertebral and pelvic  
 is still the subject of controversy.  
 He contends that "it results from far-  
 tion of the primary growth along the  
 asial lymphatic plexus." He ap-  
 showed that carcinoma of the  
 often invades the epigastric node,  
 there reaches the lumbar lymph  
 the lumbar vertebrae by second-  
 ic infection from other abdominal  
 deposits in the later stages of the

bladder  
 as exceptional, or a  
 the breast metastasizes,  
 all other tumors?" The lym-  
 tion theory of Handley is ac-  
 Simpson, Deaver, Carnett, and  
 surgeons who have written on car-  
 of the breast. Opposing this view, Levin  
 asked for an explanation of how distant  
 metastasis can take place without local  
 recurrence after operation unless the car-  
 cinoma cells were transplanted during the  
 operation. In his textbook on carcinoma  
 of the breast, Fitzwilliams stated: "I can  
 only conclude by saying that after giving  
 very careful attention to all the writings  
 and arguments on the subject I have not  
 met a single fact that would support the  
 argument in favor of permeation, as every-  
 thing can be explained by the far simpler  
 method of blood borne or lymphatic em-  
 boli." Piney said that the bone marrow  
 becomes involved by emboli in the blood  
 stream. The bones which have red mar-  
 row, the ribs, sternum, vertebrae, and  
 innominates, are most likely to be the seat  
 of metastasis.

A direct, definite relationship of the  
 bone marrow to the general lymphatic  
 system is of greatest significance in the  
 clinical pathology of secondary tumors from  
 carcinoma of the breast. Lymph capillaries  
 have been described accompanying the  
 blood vessels in the bony marrow, in



radiation. Boston.  
and ISAACS, R. (1915)  
(lymphoma).  
of disease  
roentgen-ray  
therapy. J.  
cancer -  
tion of the  
case, and,  
ence should approach  
t. However, from the literature  
percentage is difficult to deter-  
mine. It is obvious that at necropsy many  
are missed unless there is some in-  
dication for examination of the vertebral  
and pelvic bones, and even then metastasis  
that has not produced gross destruction of  
bone will not necessarily be discovered.  
Clinicians naturally diagnose only those  
cases in which symptoms are severe enough  
to warrant a definite opinion that a lesion  
of bone is present.

Handley, in 329 necropsies at the Middle-  
sex Hospital in cases of carcinoma of the  
breast, found involvement of bone in 73  
cases, an incidence of 22 per cent. Risley  
found about 25 per cent. Giles stated that  
there is metastasis to bone in an average of  
30 per cent; in Kaufmann's<sup>49,50</sup> series the  
incidence was 53 per cent; in Snow's small  
series of unselected cases it was 73 per  
cent, and in Ginsburg's<sup>52,53</sup> series of cases  
studied at the Montefiore Hospital the  
incidence was about 75 per cent. Ingraham  
and Kitain asserted that osseous metastasis  
occurs more commonly than available  
statistics lead one to believe. One might  
suspect that the percentage-incidence varies  
in proportion to the thoroughness with  
which one examines patients for metastasis  
to bone; or else the great discrepancy in  
these figures may depend on the types of  
cases studied.

The fact that carcinoma of the breast  
may metastasize early is not taken seriously

pelvis many  
long time without other  
out symptoms or apparent ch  
patient's condition. The high incidence of  
skeletal metastasis makes it an important  
problem for the pathologist, the internist  
and the radiologist, because carcinoma of  
the breast is one of the commonest forms  
of malignant disease, and its mortality  
rate is apparently still on the increase. In  
many cases in which the bone is involved  
the patients suffer from severe symptoms  
for months before they finally succumb to  
the ravages of the disease, or to intercur-  
rent infection. The general opinion is that  
treatment in such an advanced stage of the  
carcinoma is useless, since osseous metas-  
tasis is highly resistant to roentgen ther-  
apy.

The value of roentgen therapy for skele-  
tal metastasis is difficult to determine,  
because, notwithstanding its frequency,  
few systematic studies of treatment have  
been made. Most papers deal with the  
pathologic or roentgenographic phases of  
the subject; clinical reports of one or two  
cases are frequent, generalizations are  
commonly made from insufficient evidence,  
and diametrically opposed statements are  
common. In many reports the number of  
definitely diagnosed cases is uncertain,  
the technique is not described or is  
ambiguously. Some authors advocate  
roentgen therapy for metastasis, and  
not only useless, but dangerous. Others  
as positively state that treat-  
ment of such lesions gives brilliant re-  
sults. That osseous metastasis is the  
field in inoperable carcinoma

...be as-  
...which carci-  
...by the blood stream,  
...in the capillaries of the  
...arrow. The wider caliber of the  
...of the bone marrow, the thinness  
...their walls, and their inclosure in a shell  
...of bone, lead to retardation of the blood  
...stream in the capillaries and small veins  
...and to peripheral stagnation where the ma-  
...lignant cells grow and multiply. The fact  
...that in metastatic carcinoma of bone it is  
...easy to find veins filled with carcinoma  
...cells, and the general opinion that the bone  
...marrow is lacking in lymph vessels and has  
...no relation to the general lymphatic system  
...is the most forceful argument presented by  
...those who accept the circulatory-mechani-  
...cal theory of von Recklinghausen.

Handley was the first to assert that me-  
...tastasis of carcinoma to the skeleton differs  
...in no way from metastasis to other organs,  
...and that the route of invasion of the  
...metastasis is usually that of carcinomatous  
...invasion of the lymphatic system. He ex-  
...pressed the view that carcinoma cells  
...invade the bone by way of the lymph  
...vessels entering the bone at the points of  
...insertion of muscles. However, Kolodny,  
...in a series of experiments, showed a direct  
...relationship between the bone marrow and  
...the lymphatic system, and he stated that  
...there is no need to invoke more or less  
...hypothetic lymph vessels entering the  
...bone at the points of insertion of tendon.  
...Kolodny expressed the belief that the  
...direct relationship he demonstrated be-

...carri-  
...ate this point. It  
...carcinomatous invo-  
...the lymph nodes frequ-  
...sion of the efferent ves-  
...stages of the involvement  
...node, carcinoma cells are found  
...subcapsular lymph sinuses, at the p-  
...entry of the efferent lymphatics. La-  
...these cells compress the pulp and lead to  
...atrophy of the lymphoid tissue and to  
...obliteration of the node. Then the carci-  
...noma cells invade the capsule and the  
...peripheral vessels; obliteration of the  
...sinuses of the node follows, causes a retro-  
...grade lymph flow, and nullifies the im-  
...portance of this node as a guard against  
...further infection. In such cases, aber-  
...rant lymph capillaries develop. These are  
...channels for communication between the  
...afferent and efferent vessels of the obliter-  
...ated node, as has been proved experiment-  
...ally. Such an aberration of the lymph  
...stream readily explains the so-called par-  
...adoxical metastasis which occurs when  
...carcinoma skips the regional node and  
...yields distant metastasis.

Metastatic involvement of the  
...the opposite side from that of the  
...tumor frequently is found. Kolo-  
...plained this as either a case of  
...carcinomatosis in which the  
...overflowing with carcinoma cells  
...of a tumor in a more or less early  
...which the cells are brought to the  
...side by lymph vessels that cross the  
...median line. He showed experi-

on of the lymph stream. In the circulatory systems, may be used to trans- their general spread.

carcinoma, having invaded may cause formation of individual nodules, or diffuse infiltration (as a result of which the whole spongiosa of a vertebra, or the head of the femur, may be filled with carcinomatous tissue). Then it may grow along the vessels of the cortex to the surface and form nobby subperiosteal thickening, or there may be multiple diffuse regions of absorption of bone.

#### TYPES OF METASTASIS

It is generally accepted that there are two forms of skeletal metastasis, the osteoclastic and osteoplastic, although both forms commonly exist together. In the former, the tela ossea are resorbed, and much of the cortex is destroyed, so that the bone may fracture under the least trauma; in the latter, the tumor forms new bone in place as a result of which the bone becomes broader and heavier. In the higher grades there is a compact, finely porous structure in the spongiosa, and the superjacent deposits have the same structure. The bone has the appearance of hyperostosis or osteosclerosis (Aschoff).

#### HISTOPATHOLOGY

von Recklinghausen first made the observation that large polynuclear osteoclasts destroy the bone in osteoplastic metastases. These are found in the lacunae of bone surrounding a growing metastatic

and similar to the opinion of Apolant, Erbslöh, of the opinion of carcinoma. aid of the one and, Wolff<sup>93</sup>

pressed the belief that the cells as osteoclasts and destroy the compact bone. Axhausen maintained that the small, elongated, mononuclear connective tissue cells frequently found close to the walls of the lacunae, are special osteoclasts derived from the stroma of the carcinoma. But even if this were true the tumor itself first destroys the bone and then grows by occupying the space it has produced. von Recklinghausen claimed that such extensive formation of new bone is due to hyperemia and hemostasis from obstruction of the capillaries by endovascular tumor emboli. Courvoisier and Kaufmann<sup>49,50</sup> maintained that a metastatic deposit in bone is always surrounded by a zone of inflammation, and that this causes the sclerosis. Askanazy expressed the belief that the metastasis at first produces osteoporosis, which is followed by necrosis of bone, and that such necrotic bone acts as a foreign body to produce new bone. Wolff,<sup>92</sup> Courvoisier, and Kaufmann hold that carcinoma cells may act as osteoblasts and form new bone. In his series of cases Helly did not mention lymphocytic infiltration. Levin did not find hyperemia, inflammation, or other abnormality, and agreed with Axhausen, Schmorl, and Mueller that some chemical irritant emanating from the carcinoma cells acts on bone and stimulates its proliferation.

That skeletal metastasis gives rise to marked inflammatory reactions of non-infectious origin, has been recognized since 1886 when Lanzinger wrote about it. In 1891 von Recklinghausen stated the



istic symptom of involvement secondary to carcinoma of the breast. At the outset this pain may be intermittent and transitory. It may consist only in stiffness, weakness, or a "catch" in the back which the patient regards as a "cold," and which is treated with home remedies. Motion of the spinal column always intensifies the pain, and rest relieves it. As time goes on, the pain becomes more severe and more constant and the diagnosis of lumbago or sciatica is often made. Sciatica is a subject of great antiquity and corresponding vagueness. The first good description of sciatica was that by Cotugno, but the most exhaustive early report was that by Valleix, who reviewed the literature to 1840. Simonson cited some cases treated by roentgen therapy and gave early references on the subject. The fact that in many cases the pain is recurrent and is not due to actual disease or injury of the sciatic nerve is becoming widely recognized. Seldom is there actual destruction of the nerve itself, but in all cases of "sciatica" of this kind can be traced to a disturbance in a nearby joint to which the sciatic nerve is attached by a filament. However, when there is involvement of the lymphatic system adjacent to the nerve or to branches of the lumbosacral plexus, the pain is of a mechanical origin.

...press itself in p... Besides this process... from the diseased bone... pressure neuritis. The upper... nerve descends into the pelvis... of the sacroiliac joint, supplying... since this joint is often involved by... secondary malignant deposits from carcinoma of the breast, and since the joint is unstable in comparison with the spinal column and hip-joint, it is not hard to understand how malignant disease at this point may manifest itself by pain along the distribution of the sciatic nerve. The nerve leaves the pelvis to enter the buttock through the great sacrosclatic foramen. Involvement of the bony margins of this notch may also produce direct pressure on the nerve. As the nerve descends it lies behind the hip-joint, which it supplies. Tumors in the vicinity, or lesions in the upper part of the femur, may irritate... In the thigh, the sciatic nerve supplies hamstring muscles, and at times is... on or irritated by secondary... in the shaft of the femur. Usually, the sciatic nerve divides in the thigh into... which supply all the muscles... the knee and nearly all the sensa... sciatic pain is, as a rule, rarely... of only in the buttock. The... not necessarily follow the whole... may be confined even below the... best cases, the exciting cause is... lumbar part of the spinal... sacroiliac joint, or in the... directly upon the... denation de-

...the structures... growth was invo... the local remedies... neuritis... further... prescribed... is the possible... and more... used... is the possible... into a cast. At this stage... spinal column usually is lacking... pressure on the spinal column does not... pain. In spite of the severity of symptoms, the dangerous practice of massage is often carried out, usually without a roentgen examination to ascertain the possible presence of metastasis, until, suddenly, a pathologic fracture reveals the true underlying cause of the pain. The fact that the patient has had a carcinoma of the breast is often ignored or completely forgotten. Patients may have skeletal metastasis for months without evidence of local recurrence or evidence of visceral metastasis. Cachexia is rarely noted in this group and yet carcinoma is often ruled out merely because the patient is not cachectic. The weights of 5 of the patients in this series, at the time of their first course of roentgen therapy, were 100 pounds or less; 9 were of average weight (135 pounds); 13 were stout (150 pounds); 9 were obese (170 pounds), and the weight of 4 was not recorded. It is well to emphasize again, contrary to the prevailing opinion that the pain from the skeletal metastasis is constant, persistent and progressive, that pain in the early stage may be mild, fleeting, inconstant or indefinite. Of the 40 patients in this series, 2 complained of mild pain, 20, of severe pain, and 18, of crippling pain. The duration of the pain is shown in Table 1. The pain was usually of widespread distribution, and varied from the duldest to the most irritating

or is

stasis, and  
may seem to  
be a diagnosis.  
examination  
lost rect

TABLE  
CONDITION OF PATIENTS WHO UNDERWENT PRIMARY EXAMINATION

Case	Age, years	Breast involved	Size of carcinoma, cm.	Report of microscopic examination	Extent of involvement of axilla
1	42	Right	Not given	Carcinoma	Graded 3
2	46	Left	2 by 3	Carcinoma	None
3	31	Left	Not given	Graded 3	Involved
4	57	Left	3.5	Small cell carcinoma	None
5	53	Left	2	Carcinoma	Graded 3
6	52	Left	3 by 2	Carcinoma	None
7	45	Right	Large	Scirrhus carcinoma	Graded 4
8	53	Left	4 by 3	Carcinoma	None
9	56	Right	7 by 4	Graded 3	Graded 2
10	34	Left	8	Carcinoma	Graded 3 or 4
11	54	Right	5	Carcinoma	Graded 2
12	53	Left	6 by 4	Adenocarcinoma, graded 4	Graded 4
13	49	Left	5 by 2.5	Carcinoma	Graded 2
14	37	Left	3	Carcinoma	None
15	58	Right	4 by 4	Carcinoma, graded 4	Graded 2
16	57	Right	4 by 3	Adenocarcinoma, graded 3	Graded 4

are of assistance in making a diagnosis of malignant osteitis have been described by Risley, Schlesinger, Flatau, Oppenheimer and Ginsburg.<sup>22, 23</sup>

Definite diagnosis is established most easily and certainly by roentgen examination. But one should always remember that metastasis may precede changes in the bones that are demonstrable in the roentgenogram, and that inflammatory osteitis may present a roentgen picture identical with that of metastasis. With a doubtful roentgenogram of the pelvis or spinal column, the diagnosis of coexisting

larged on here. As one reviews the roentgenograms of the cases on which this study is based, certain outstanding facts are disclosed. Most obvious is that the commonest site of metastasis is the vertebrae, the sacroiliac joint; next in frequency is the sacrum, then the lumbar and thoracic spinal column, more uncommonly the femur, and rarest of all, the pelvis. In one case was there a single metastasis in one bone as the cause of pain. In another, involvement of one or more vertebrae accompanied by areas of metastasis in the pelvis and femur.



produce the greatest number of metastatic areas, nor did it appear that metastasis was commonest from scirrhus carcinoma. There was in the group considered here no constant relationship between the structure of the primary tumor and its metastatic vertebral and pelvic lesions as far as could be determined. In brief, this study bears out the well-known dictum that "the living world knows no constants." In 2 cases, consideration of the metastasis alone did not permit differentiation of a lesion secondary to carcinoma of the breast and metastasis from a prostatic primary carcinoma. The structure of the pelvis and the sex of the patient, of course, cleared up all doubt.

There was no relationship between the situation of the largest metastatic growth, as shown in the roentgenogram of the pelvis and the result of treatment, nor between the site of the growth and the site of the pain, nor between the site of the metastasis and the degree of pain.

It is a strange clinical fact that pain from metastasis may exist in patients the roentgenographic examination of whose pelvis gives negative results. This happens in 3 cases in which treatment was given, which are not included in this study because the diagnosis was "arthritis."

The difficulty of distinguishing between inflammatory arthritis and metastatic carcinoma is well known to be other than simple. The negative data in the 11 cases considered, however, may be considered as evidence that the

The occurrence of pain in the hip or thigh, irrespective of the site of metastasis shown in the roentgenogram in 31 of 40 cases in this series (2 patients had pain in the left hip only, and 7 in both hips) is too high to be mere accident or coincidence. That such a high proportion of pain does occur on the right side is a fact not mentioned in any of the works I have reviewed. The explanation of such a phenomenon is obscure and merits further neurologic investigation. The occurrence of right-sided pelvic or femoral pain in a patient who has or has had a carcinoma of the breast is a point to remember in making a differential diagnosis of osseous metastasis.

#### TREATMENT

Various methods of treating the pain of metastatic carcinoma of bone have been reported, but as a whole the patients who suffer from the unbearable agonies of malignant involvement of vertebrae and pelvis have been treated with analgesics and sedatives. Joll stated: "Treatment will seldom be undertaken if the true secondary nature of the tumor be recognized. It is perhaps a counsel of perfection to suggest that all bone tumors should be explored and examined microscopically before any radical operation is undertaken. As a rule the benefit to be expected from operations on secondary growth of the bones is but transitory." The combination of increasing doses of sedatives, with casts or braces and the use of heat or cold

carcinoma  
the left  
in the  
left

with p  
arce  
the  
c  
most a resurrection) from roentgen therapy of osseous metastasis have been known. Strangely, this fact has not received widespread attention, for the literature contains few references to systematic studies on the subject. Matthews, in 1915, could find no record of radiotherapy of secondary malignant disease in bone. Isolated reports of benefit are common, and improvement subsequent to radiotherapy of osseous metastasis is often mentioned incidentally, although many have reported excellent results in the treatment of one to five cases. It is true that some authors have reported failures or indifferent results (Rahm, Jüngling, Flatau, Kaestle, and Carter) but as a whole they have been extremely encouraging, so much so, in fact, that Borak<sup>11,12,13,14</sup> stated that osseous metastasis is the most favorable field in the treatment of inoperable carcinoma. As in most fields of roentgen therapy, the technique and indications of treatment are largely individual to the therapist.

For reasons that are not at all certain, the common opinion is that metastatic carcinoma of bone is resistant to irradiation. It is surprising, therefore, in the light of such opinion, that some excellent results were obtained by moderate divided doses. Even though recent literature contains many reports of cases in which patients have been improved, results are improved. A previous one, to justify

More recently he  
moderate doses of high voltage  
rays and he reported 5 cases in which life was prolonged for from one to four years. Such results are interesting in the light of the investigation of Meyerding, Carman and Garvin who, in 25 cases, determined that life expectancy is on the average four and seven-tenths months after the discovery of the metastasis. Jenkinson reported 3 cases in which patients were alive after three years, comparatively free from pain. He used high voltage roentgen rays, heavily filtered in moderate doses, and advised treatment in all such cases no matter how hopeless they may seem. Beck reported one case in which recalcification followed high voltage treatment of the pelvis. Belot and Lepennetier obtained indifferent results in the treatment of their patients. Giles had 7 cases, in 2 of which treatment was with high voltage. Pop reported 4 cases treated with 1.5 H.E.D. Palumbo treated 3 patients with 140 per cent H.E.D., according to the Seitz-Wintz technique, with indifferent results. Holmes mentioned one case in which the patient was improved by roentgen rays of high voltage. Joly reported a patient in whom the roentgen rays gave evidence of recalcification of the thoracic vertebra and freedom from pain seven months after treatment. De Nabias reported one case in which the patient was improved. De Nabias reported one case in which the patient was improved. De Nabias reported one case in which the patient was improved.

...2 was  
...of 40 cases  
...were treated for relief  
...8 were given placebo treatment; large  
...for its psychic effect. Of the 32 patients  
...treated for relief of pain, in only 2 did  
...the analgesia fail to appear. The period  
...after treatment within which analgesia  
...began was less than one day after treat-  
...ment in 2 cases, two to three days after  
...treatment in 12 cases, four days to a week  
...after treatment in 8 cases, during the sec-  
...ond week after treatment in 9 cases,  
...and in one case there was slight relief one  
...week after the first treatment but definite  
...relief did not come until the second course.  
...The data are inconclusive, but in 14  
...cases in which the relief of pain began from  
...one to two weeks after treatment, the  
...analgesia lasted two to four or more  
...months, whereas in 17 cases the relief  
...was more rapid, and lasted a shorter time,  
...usually less than two months. There was  
...no demonstrable relationship between the  
...speed of onset of the relief from pain and  
...its degree, and none between the time of  
...onset of analgesia and its duration. In  
...2 cases in which treatment failed,  
...roentgenograms were positive for metas-  
...s. I have no plausible explanation for  
...these results in these cases.

...technique of treatment in this  
...brings out some very interesting,  
...clinical facts. From the stand-  
...points alone, both moderate\* and  
...large produced analgesia. The time  
...of onset of analgesia was

...voltage: 135 kv. (peak); 5 ma.; 40 cm. target-  
...aluminum filter; 30 to 35 min. exposure.  
...voltage: 200 kv. (peak); 5 ma.; 50 cm. target-skin  
...min. exposure; 1 mm. aluminum filter; 60 to

...treated with either technique, on  
...the second to the fifth day after treatment.  
...On closer investigation it appears that  
...those patients treated with subintensive  
...cross-fire of the pelvis with high voltage  
...and the thoracolumbar part of the spinal  
...column with moderate voltage seemed to  
...get greater and longer relief than those  
...in whom only the pelvis or diseased vertebra  
...was treated through a single field.  
...Cross-fire was more generally effective than  
...treatment through a single field.

In considering results of treatment,  
...there are two distinct phases to keep in  
...mind: the symptomatic effect on the  
...patient, and the organic changes in the  
...lesion. That there is parallelism between  
...them does not necessarily follow, as the  
...reports of Desjardins and Ford, on the  
...analgesic effects of roentgen rays, bring  
...out. They, and others, have stated that  
...analgesia results sometimes from destruc-  
...tion by roentgen rays of inflammatory  
...or neoplastic processes, which impinge on  
...nerves. However, in a considerable num-  
...ber of patients, such a mechanism does  
...not come into play, and the assumption  
...is that there is a direct effect of unknown  
...nature on the nerve. There probably take  
...place, therefore, three processes in relief  
...of pain from osseous metastasis: destruc-  
...tion of inflammatory and of carcinoma  
...cells, and direct action on the nerves.

To determine the effect of irradiation  
...on a tumor, two factors are of fundamen-  
...tal importance: an adequate dose  
...must be absorbed, and suf-



is the exception rather than the rule.

In some of these cases, the analgesia apparently came on too soon (one to five days) after too small doses of roentgen rays, for the effect to be mainly due to destruction of tumor and relief of pressure on nerve filaments. It must therefore be assumed either that carcinoma of the breast metastatic in bone has a sensitivity exceedingly greater than has the primary tumor as a rule, or that some other effect is the basis for the production of early analgesia.

In support of the first possibility is the work of Borah, Berven and others, who assigned an extremely high radiosensitivity to metastatic lesions in bone from carcinoma of the breast.

Earlier in this paper it was stated that a noninfectious inflammatory reaction has been observed by many authors as the accompaniment of carcinomatous deposits in bone. The frequency of this phenomenon is too great to be ignored. Although many have noted its presence, but have assigned to it a rôle of no clinical importance, it is, nevertheless, the destruction of this infiltrate which probably plays the major part in the early production of analgesia.

The great sensitivity of chronic inflammatory processes to moderate doses of roentgen rays has been established. The reports of Heidenhain and Fried, of Pordes, Bauer, Hodges, Liebersohn, and many others, have shown the rapid regression of inflammation in all situations

to follow the same course as the destruction of the inflammatory tissue probably explains the onset of analgesia within the first week after treatment.

In all cases in which treatment is given there takes place, coincidentally with the effect on the inflammation, an effect on the carcinoma. When the analgesic effect was slight, either there was little inflammation present, or the effective dose in the carcinoma was low. The malignant disease was merely slowed up, or the tissue only partly destroyed, and after a time the disease became active again. In those cases in which analgesia came on late (after more than a week), and was of long duration, the effect was probably on the carcinoma cells basically and on the inflammatory cells incidentally.

In some cases, almost complete analgesia of long duration followed treatment with high voltage. That such a technique is more effective than moderate voltage in deep-seated pelvic metastasis is a radiotherapy axiom. This leads to the supposition that radiation at high voltage produces not only an actual curative effect in the underlying malignant process, and that moderate voltage is effective in giving symptomatic relief by its action on the inflammation. The course of analgesia is probably destruction of the inflammatory lesions first (and early), while the analgesia lasting until the second week when the reaction on carcinoma begins to manifest itself, giving rise to the clinical result.

It is not uncommon for

21. EAST, R. H. Röntgen treatment of carcinoma of the breast. *Am. J. Roentgenol.*, 1924, 2, 153.
22. ELLIS, H. Röntgen treatment of carcinoma of the breast. *Am. J. Roentgenol.*, 1924, 2, 153.
23. ELLIS, H. Röntgen treatment of carcinoma of the breast. *Am. J. Roentgenol.*, 1924, 2, 153.
24. ELLIS, H. Röntgen treatment of carcinoma of the breast. *Am. J. Roentgenol.*, 1924, 2, 153.
25. FLATAU, EDWARD. Wirbel- und, to al- marksgeschwülste. In: Handbuch der Neurologie. Zweiter Band spezielle neurologie. I. Julius Springer, Berlin, 1911, 616-684.
26. FRANCES, A. Roentgenotherapy in certain types of neuritis and neuralgia. *Minn. Med.*, 1928, 11, 368-374.
27. FRAENKEL, E. Ueber Wirbelgeschwülste im Röntgenbilde. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1910-1911, 16, 245-257.
28. FREUND, LEOPOLD. Röntgenbehandlung der Ischias. *Wien. klin. Wchnschr.*, 1907, 20, 1611-1612.
29. FITZWILLIAMS, D. C. L. On the Breast. C. V. Mosby Co., St. Louis, 1924, p. 408.
30. GEORGE, A. W., and LEONARD, R. D. The vertebrae. *Annals of Roentgenology*, 1929, 8, 46.
31. GILES, R. G. Skeletal metastasis from primary carcinoma of the breast. *Am. J. Roentgenol. & Rad. Therapy*, 1925, 14, 442-448.
32. GINSBURG, S. Osteoplastic skeletal metastases from carcinoma of the breast; report of unusual case. *Arch. Surg.*, 1925, 11, 219-236.
33. GINSBURG, S. Pain in cancer of the breast; its clinical significance with special reference to bone metastases. *Am. J. M. Sc.*, 1926, 171, 520-535.
34. GOETSCH, W. Über der Einfluss von Karzinommetastasen auf das Knochengewebe. *Beitr. z. path. Anat. u. z. allg. Path.*, 1906, 39, 218-251.
35. GOFORTH, J. L. A consideration of body resistance to neoplasia. *Am. J. M. Sc.*, 1928, 175, 504-510.
36. HANDLEY, W. S. Cancer of the Breast and its Treatment. Second edition. Paul B. Hoeber, New York, 1927, 1001.
37. HANDLEY, W. S. Cancer of the Breast and its Treatment. Second edition. Paul B. Hoeber, New York, 1927, 1001.
38. HANDLEY, W. S. Cancer of the Breast and its Treatment. Second edition. Paul B. Hoeber, New York, 1927, 1001.
39. HANDLEY, W. S. Cancer of the Breast and its Treatment. Second edition. Paul B. Hoeber, New York, 1927, 1001.
40. HANDLEY, W. S. Cancer of the Breast and its Treatment. Second edition. Paul B. Hoeber, New York, 1927, 1001.
41. HANDLEY, W. S. Cancer of the Breast and its Treatment. Second edition. Paul B. Hoeber, New York, 1927, 1001.
42. HANDLEY, W. S. Cancer of the Breast and its Treatment. Second edition. Paul B. Hoeber, New York, 1927, 1001.
43. HANDLEY, W. S. Cancer of the Breast and its Treatment. Second edition. Paul B. Hoeber, New York, 1927, 1001.
44. JENKINSON, E. L. The roentgen treatment of breast carcinomata. *Radiology*, 1924, 2, 153.
45. JOLL, C. A. Metastatic tumours of bone. *Eng. J. Surg.*, 1923, 11, 38-72.
46. JOLY, M. Radiodiagnostic et radiothérapie d'un cancer secondaire de la colonne dorsale. *Bull. et mém. Soc. de radiol. méd. de France*, 1926, 14, 198.
47. JÜNGLING, O. Röntgenbehandlung chirurgischer Krankheiten zugleich Einführung in die physikalischen und biologischen Grundlagen der Röntgentherapie. S. Hirzel, Leipzig, 1924, 468 pp.
48. KAESTLE, K. In: Rieder, Hermann, and Rosenthals, Josef. Lehrbuch der Röntgenkunde. J. A. Barth, Leipzig, 1922, p. 292.
49. KAUFMANN, E. Quoted by Ginsburg.
50. KAUFMANN, EDWARD. Lehrbuch der pathologischen Anatomie. P. Blakiston's Son & Co., Philadelphia, 1929, ii, 1222.
51. KELLY, H. A., and FRICKE, R. E. Problems in the treatment of carcinoma of the breast. *Gynec. & Obst.*, 1924, 38, 399-402.
52. KIENBÖCK, R. On the tumorous disease of the bones, primary and metastatic. *Radiol.*, 1926, 31, 374-385.
53. KITAIN, H. Zur Kenntnis der Häufigkeit der Lokalisation von Krebsmetastasen besonderer Berücksichtigung histologischen Baues. *Arch. f. path. Anat. u. exp. Med.*, 1928, 238, 289-309.
54. KLEIN. In: Gray, Henry. An.

- ans and
- Ginsburg
- The tre
- ery inopera carcinoma of
- liation. *Radiology*, 1924, 2, 12
- Recur
- ia of breast; analysis
- hym and roent
- 86, 250-256.
- carcinom.
- 280-2
- Kasuistisc
- anatomie der Wirb
- Röntgenstrat
- anatomy
- 2, 792
- elastis
- osteo
- fluss
- skete
- Stom
- Die Röntgentherapie des
- Chirurgen. F. Enke, Stuttgart, 1927, 547 pp.
80. VON RECKLINGHAUSEN, F. Die Fibröse oder deformirende Ostitis, die Osteomalacie und die osteoplastische Carcinose in ihren gegenseitigen Beziehungen. *Festschr. R. Virchow*, 1891, 1-89.
81. RISLEY, E. H. Skeletal cancer. *Bo*, 1915, 172, 584-587.
82. RITCHIE, J., and STEWART, J. P. General secondary carcinoma of the bones, osteomalacia carcinomatosa. *Edinburgh M. J.*, 1896-1897, 43, 208-220.
83. ROGER and JOSUÉ. Quoted by Kolodny.
84. SCHINZ, H. R., BAENSCH, W., and FRIEDL, E. Lehrbuch der Röntgendiagnostik. G. Thieme, Leipzig, 1928, pp. 199-207.
85. SCHLESINGER, HERMANN. Die Diagnose und Therapie der karzinomatösen Wirbelmetastasen. *Wien. klin. Wchnschr.*, 1928, 41, 205-206.
86. SCHMORL, G. Ueber Krebsmetastasen im Knochensystem. *Verhandl. d. deutsch. path. Gesellsch.*, 1908, 12, 89-94.
87. SICARD, J. A., BELOT, J., COSTE, and GASTAUD. Aspects radiographiques du cancer vertébral. *J. d'Radiol. et d'électrol.*, 1925, 9, 353-382.
88. SICARD, J., LERMOYEZ, J., and LAPLANE, L. Les signes radiologiques du cancer vertébral. *Ann. de méd.*, 1923, 13, 383-389.
89. SIMONSON, S. Die schmerzstillende Wirkung der Röntgen- und Radiumstrahlen. *Strahlentherapie*, 1913, 2, 192-223.
90. SIMPSON, B. T. Pathology of breast cancer with special reference to metastasis. *Am. J. Roentgenol. & Rad. Therapy*, 1926, 16, 431-439.
91. SNOW, HERBERT. The insidious marrow lesions of mammary carcinoma. *Brit. M. J.*, 1892, 1, 548-551.
92. WOLFF, RICHARD. Zur Kenntniss der metastatischen Erscheinungen des Prostatacarcinoms. *Deutsche Zeitschr. f. Chir.*, 1892, 1, 1-10.
- L
- si
- cin
- 65, 3.
- LIEBERSON, J. Zur Behandlung entzündlicher Erkrankungen mit Röntgenstrahlen in kleinen Dosen. *Strahlentherapie*, 1929, 32, 356-360.
82. MANDL, FELIX. Zur Behandlung der durch Karzinommetastasen hervorgerufenen Ischialgien. *Wien. klin. Wchnschr.*, 1927, 40, 942-944.
84. MATTHEWS, A. A. Secondary carcinoma of the bone. *N. York M. J.*, 1915, 101, 1150-1157.
64. MEYERDING, H. W., CARMAN, R. D., and GARVIN, J. D. Metastasis to the bones from carcinoma of the breast; roentgenologic study. *Radiology*, 1925, 5, 486-489.
55. MOORE, A. B. A roentgenologic study of metastatic malignancy of the bones. *Am. J. Roentgenol.*, 1919, 6, 589-593.
66. MUELLER, BERTHOLD. Ein Beitrag zur Knochen-carcinose. *Arch. f. path. Anat.*, 1924, 249, 305-314.
67. OPPENHEIMER, E. D. Early symptoms of spinal cancer. *J. Bone & Joint Surg.*, 1922, 4, 342-356.
68. PALUMBO, V. Metastasi ossee del Bacino da carcinoma mammario operato. *Riforma med.*, 1926, 42, 515-516.
- PANCOAST. Discussion.
- ATEY, D. H. Some notes on the clinical features and the distribution of secondary deposits of bone following carcinoma of the breast. *J. Surg.*, 1927-1928, 15, 182-192.
- I, M. M. The control of intractable pain in the lumbar region, pelvis, and lower extremities by section of anterolateral columns of spinal cord (chordotomy). *Arch. Surg.*, 1913, 153-204.
- G. E. The roentgen diagnosis of metastatic malignant disease of bone. *Am. J. Roentgenol.*, 1917, 4, 114-122.
- G. E. The treatment of metastatic disease of the bone by deep roentgen



	years		
Radical operation	26	18	
Semiradical operation	19	10	7
Total.....	45	28	21

20. In carcinomas with involvement of the supra-, infraclavicular and cervical lymph nodes, 6 cases (Table VI).

TABLE VI

A III	Cases	Results	
		3 years	5 years
1922	2	I	I
1923	1		
1924	3	2	I
Total	6	3	2

IV-V. In carcinomas with generalized metastases, 10 cases (Table VII).

TABLE VII

A IV-V	Cases	Results	
		3 years	5 years
1922	2		
1923	3		
1924	5	I	I
Total	10	I	I

B. In the cases treated by radiation alone, in all stages, 18 cases (Table VIII).

C. In the recurrence following operation and treated by radiation.

ing the axillary lymph nodes (Table IX).

TABLE IX

C I-II	Cases	Untraced	Results	
			3 years	5 years
	4	I	I	I

III. In carcinomas with involvement of the supra-, infraclavicular and cervical lymph nodes, 24 cases (Table X).

TABLE X

C III	Cases	Untraced	Results	
			3 years	5 years
1922	10		3	3
1923	7	I	2	I
1924	7		4	4
Total	24		9	8

IV-V. In carcinomas with distant metastases, 48 cases (Table XI).

TABLE XI

C IV-V	Cases	Untraced	Results	
			3 years	5 years
1922	20		2	
1923	15	I	3	
1924	13		I	
Total	48	I		



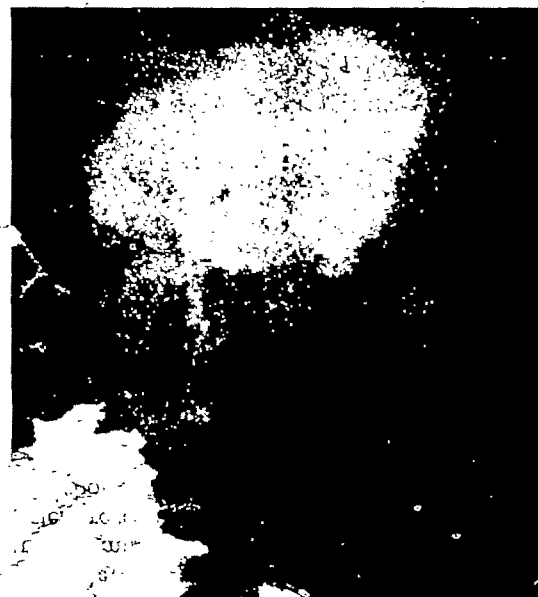
large accumulations of gas in the left hemithorax through which the lung structure could not be discerned. This was bounded above by a dense fibrous band arising from the esophageal opening of the stomach, and extending up to the first interspace in the nipple line, where it was apparently lost. Roentgenoscopic examination showed an upward excursion of this entire structure, synchronous with the right

Fig. 3. Apparent re-expansion of lung.



turbances, a gastrointestinal examination was made. This showed (Fig. 6) the barium flowing from the lower end of the esophagus into the stomach, which ascended into the thoracic cavity to the second interspace, definitely outlining the stomach. The dense band previously described as arising from the esophageal opening did not appear at this time (Fig. 6) and was probably obscured by overlying structures. The barium was observed scopically, to empty rapidly from the stomach when the patient was in the upright position, but slowed down when the patient was in the supine position, thus suggesting a filling defect.

Fig. 5. Stimulating anterior leaf of diaphragm, or upper thickened border of stomach wall.



thickening of the

life.  
 as a 30-year-old man, aged thirty, weight 150 lbs., occupation, general trucking business. In March, 1924, he was severely injured in an automobile accident, and among other injuries received four fractured ribs in the left hemithorax anteriorly. Roentgen examination at this time (Fig. 1) apparently showed a hydropneumothorax, and a plate taken a week later (Fig. 2) showed a well-defined area of collapsed lung and an apparent increased height of fluid level. Aspiration of the chest, however, at this time, brought no fluid. The heart was somewhat displaced to the right.

In 1926, two years later, re-examination of the chest (Fig. 3) showed an apparent re-expansion of this lung as evidenced by the disappearance of the collapsed area seen in Figure 2. At this time, the patient complained of

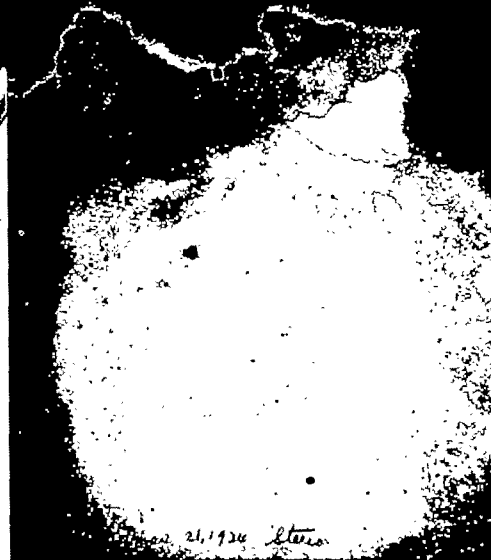


FIG. 2. Area of collapsed lung and apparent increase in amount of fluid.



FIG. 1. Fig. 2 hydropneumothorax.

In June, 1927, because of continuance of dyspnea and general malaise, he consulted a prominent internist, who, upon examination of his chest, reported a pleural thickening from the old injury, but no other abnormal findings.

In May, 1929, the patient experienced his first digestive disturbances. It will be noted that this was over five years from the time of the accident. At this time, he complained of considerable epigastric pain following meals. The pain was very severe at times. This was frequently followed by vomiting and the passage of large quantities of gas, after which he experienced considerable relief. His appetite was good, but he was afraid to eat much food for fear of distress following. He observed that he felt better if in the upright position, and he spent the entire night sitting upright in a chair. His bowels were quite regular. He had lost 35 pounds in weight. Roentgen examination of his chest at this time



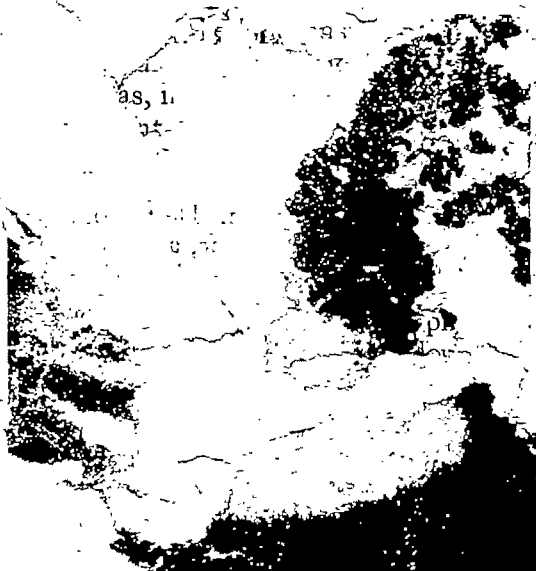


FIG. 10. Complete re-expansion of left lung following operation.

the ruptured leaves of the diaphragm were merged with the thickened walls of the stomach and the lateral chest wall by adhesions to so great an extent that they had lost their identity as such, thereby giving rise to the mistaken diagnosis of congenital absence of the diaphragm.

There was an initial pneumothorax, with lung collapsed up to the inner third of the second interspace. This lung did partially re-expand, as seen on the plate taken one



Posterior leaf of right diaphragm.

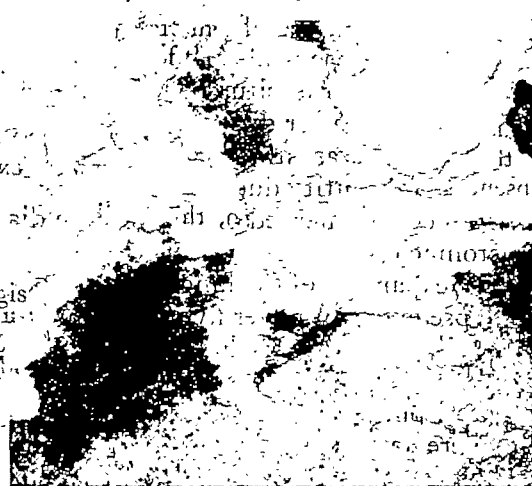


FIG. 11. Posterior leaf of left diaphragm seen above that of the right.

year later, but according to the surgical report of the operation, it was again found completely collapsed.

An interesting feature in this case is the freedom from gastric disturbances over a period of five years following the accident, though there was a progressive decline in health during this period, during all of which time, the stomach and a considerable portion of the bowels were in the thoracic



FIG. 12. Stomach and small intestine in normal position.



FIG. 6. Barium passing through lower end of esophagus into a thoracic stomach.

and the nerve re-sutured with silk. On Oct. 2, an abdominal closure of the diaphragm was made. The entire stomach, all the transverse colon and greater omentum, a portion of the splenic flexure, several loops of small bowel and all mesenteric fat were found in the left thoracic cavity, though a large opening in the diaphragm extended from the chest wall laterally about one-half inch from the esophagus. In addition, adhesions were found between the stomach and the chest wall.



FIG. 7. Stomach and colon in thoracic cavity.

The lung was completely collapsed. The opening in the diaphragm measured 20 cm., which was closed by plastic overlapping. The stomach was enormously dilated and thick-walled as was also the transverse colon."

The patient made a rather stormy convalescence, but returned home in January in robust health, after spending fourteen weeks in the hospital. He is now free from his attacks of pain, eats his meals regularly and has gained 50 pounds in weight.

Reviewing these plates in the light of the operative findings then, we find that



FIG. 8. Stomach and colon in thoracic cavity.

...woman...  
...Dec. 31, 1927, from  
...of Dr. John A. Simmons,  
...examination of the gall-bladder.  
...diagnosis was cholecystitis. Her  
...pain was pain in the epigastrium of  
...years' duration. The family and past  
...history was negative. The present history  
...dated back eight years at which time she began  
...to have attacks of sharp pain in the epigas-  
...trium, at first long intervals apart, but gradu-  
...ally becoming more frequent. At no time did  
...the pain radiate to the right shoulder or the  
...spine. There was no history of vomiting,  
...hematemesis or blood in the stools. No relation-  
...ship could be elicited between the attacks and  
...the taking of food. Sodium bicarbonate gave  
...inconstant relief. There were periods of varying  
...length in which she was entirely free from pain.  
...At times the attacks would come on at night  
...to wake her from sleep.

Roentgen examination by the Graham test  
showed evidence of chronic cholecystitis as-  
sociated with cholelithiasis. Examination of  
the stomach was not requested. Cholecystec-  
tomy was done and about sixty small gallstones  
recovered. The patient was discharged.

...ars later, Dec. 7, 1929, the same  
...as referred by Dr. S. E. Chambers  
...The gastrointestinal

...this time was  
...the epigastrium. She  
...from pain and distress for a short  
...the operation but these returned,  
...intensity and character. There  
...of hematemesis or relief from  
...The clinical diagnosis was

...quisite  
...loops of the first, sec-  
...the duodenum. The  
...attempt was made to force  
...in the horizontal loop of the  
...towards the bulb when a large globule of  
...barium "shot" out from the lumen of the duo-  
...denum and filled an ovoid sac, at first 1 cm. in  
...diameter. The sac was connected with the  
...lumen of the duodenum by a short, narrow  
...neck. Its dependent portion was not round as  
...seen normally in diverticula elsewhere but  
...pointed down and appeared to dip into the  
...head of the pancreas. The area of exquisite  
...tenderness corresponded exactly to this area.  
...At the end of five hours the stomach and small  
...intestines were completely empty but the sac  
...was still filled with barium. The roentgen  
...diagnosis was duodenal diverticulum perforated  
...into the head of the pancreas. This was con-  
...firmed by the surgeon who found the neck of  
...the diverticulum opening into the duodenum  
...just proximal and posterior to the entrance of  
...the common bile duct. It had perforated into  
...the head of the pancreas and was walled off by  
...inflammatory tissue. The sac was resected, the  
...stump inverted and closed with purse string  
...sutures. The patient made an uneventful re-  
...covery. A month later a roentgenoscopic  
...examination showed total absence of the sac  
...and its neck. There was no seepage of barium  
...from the lumen of the duodenum. The patient  
...was entirely free from all symptoms.

#### DISCUSSION

Diverticula of the duodenum are usually  
primary or congenital and occur singly. Rarely  
symptoms or signs.



ent of diaphragm, so perfect  
y clue is the somewhat  
sion involving the posterior  
comparing Figures 10 and  
11, later plates, Figure 10 showing the  
appearance on moderate inspiration and  
Figure 11 on deep inspiration.

Gastrointestinal examination upon his



FIG. 13. Colon restored to normal position.

return (Figs. 12 and 13) shows the entire  
abdominal contents, stomach, bowel, and  
so forth, restored to their normal position.





FIG. 1. Barium-filled sac of the duodenal diverticulum. Its connection with the duodenum are well seen.

overlooked, not only by the clinician but by the surgeon as well and are discovered by the roentgen ray accidentally. Sometimes, they are inflamed, producing diverticulitis, in which instance they give rise to signs and symptoms suggestive and even pathognomonic of duodenal ulcer. Lesions of the gall-bladder and duodenum may be associated with it. When large or surrounded by inflammatory adhesions producing partial obstruction vomiting is a prominent sign. Perforation must be a rare complication. No report of such a case in the American literature has come to my attention. True diverticula should not be confused with secondary dilatations or pouch formations as the result of duodenal stasis, perforated and encapsulated duodenal ulcers or traction pouches formed by adhesions.

#### CONCLUSIONS

The following points are worth stressing:

1. It is often impossible to make abso-

not have been relieved.

4. The appeal for thorough examination is well justified in upper, gastrointestinal disorders. Every of the true cause will amply repay the roentgenologist for his systematic, painstaking search, provided these ob- lesions are constantly borne in mind.



FIG. 2. The diverticulum is empty but the outline is outlined.

## and Standing Committee

### AN ROENTGEN SOCIETY

*President:* A. B. MOORE, Washington, D. C.;  
*Vice-President:* LEOPOLD JACHES, New York City;  
*President:* E. L. JENKINSON, Chicago, Ill.;  
*Vice-President:* E. P. PENDERGRASS, Philadelphia,  
*Secretary:* JOHN T. MURPHY, 421 Michigan  
Toledo, Ohio; *Treasurer:* WILLIAM A. EVANS,  
Peterboro St., Detroit, Mich.; *Librarian and*  
*Historian:* E. H. SKINNER, Kansas City, Mo.  
*Executive Council:* L. R. Sante, Chairman, 606  
Missouri Bldg., St. Louis, Mo., F. M. HODGES, Rich-  
mond, Va., CHARLES A. WATERS, Baltimore, Md.,  
A. B. MOORE, Washington, D. C., LEOPOLD JACHES,  
New York City, LAWRENCE REYNOLDS, Detroit,  
Mich., JOHN T. MURPHY, Toledo, Ohio, WILLIAM A.  
EVANS, Detroit, Mich.

*Committee on Laws and Public Policy:* B. R. KIRK-  
LIN, Chairman, Rochester, Minn., FRED M. HODGES,  
Richmond, Va., WILLIAM E. CHAMBERLAIN, San  
Francisco, Calif.

*Committee on Safety and Standards:* P. M. HICKEY,  
Chairman, University Hospital, Ann Arbor, Mich.,  
K. PANCOAST, Philadelphia, Pa., W. D. COOL-  
idge, Schenectady, N. Y., A. U. DESJARDINS,  
Rochester, Minn., H. J. ULLMANN, Santa Barbara,  
Calif., B. H. NICHOLS, Cleveland, Ohio, G. E.  
HARDS, Toronto, Canada, R. R. NEWELL, San  
Francisco, Calif.

*Committee:* WILLIAM A. EVANS, Chair-  
man, Detroit, Mich., L. R. SANTE, St. Louis, Mo.,  
Richmond, Va.

*Committee:* P. M. HICKEY, Chair-  
man, Ann Arbor, Mich., W. B. BOWMAN, Los  
Angeles, Calif., A. C. CHRISTIE, Washington, D. C.,  
Detroit, Mich., G. W. GRIER, Pitts-  
burgh, Pa., B. H. NICHOLS, Cleveland, Ohio, G. E.  
HARDS, Philadelphia, Pa.

*Committee:* DAVID R. BOWEN, Chairman,  
Kansas City, Mo., F. M. HODGES, Richmond,  
Va., G. E. HARDS, Philadelphia, Pa.

*Committee:* F. M. HODGES, Chairman,  
Richmond, Va., G. E. HARDS, Philadelphia, Pa.,  
Detroit, Mich., W. L. CLARK, Philadelphia, Pa.

July 27-31, 1931: P. M. HICKEY,  
Alternate: G. E. PFAHLER, Philadelphia, Pa.

*Editor:* LAWRENCE REYNOLDS, 110  
Building, Detroit, Mich.

*Editorial Board:* A. C. CHRISTIE, Wash-  
ington, D. C., W. B. BOWMAN, Los Angeles, Calif.,  
W. L. CLARK, Philadelphia, Pa., W. M. DUANE,  
New York City, N. Y.

*Advisory Board for Pathology:* J. A. H. REYNOLDS,  
EUGENE OPIE, ALDRED S. WARTHIN.

*Publisher:* CHARLES C. THOMAS, 220 East Mon-  
roe St., Springfield, Ill.

*Thirty-second Annual Meeting:* Atlantic City,  
N. J., September, 1931.

### THE AMERICAN RADIUM SOCIETY

*President:* H. J. ULLMANN, 1520 Chapala St.,  
Santa Barbara, Calif.; *President-Elect:* SANFORD  
WITHERS, Denver, Colo.; *First Vice-President:*  
BURTON J. LEE, New York City; *Second Vice-*  
*President:* EDWARD H. SKINNER, Kansas City, Mo.;  
*Secretary:* G. W. GRIER, Jenkins Arcade, Pitts-  
burgh, Pa.; *Treasurer:* ZOE A. JOHNSTON, Jenkins  
Arcade, Pittsburgh, Pa.

*Executive Committee:* CURTIS F. BURNAM, Chair-  
man, 1418 Eutaw Place, Baltimore, Md., EDWIN C.  
ERNST, St. Louis, Mo., H. H. BOWING, Rochester,  
Minn.

*Program Committee:* SANFORD WITHERS, Chair-  
man, 304 Republic Bldg., Denver, Colo., BURTON J.  
LEE, New York City, HENRY SCHMITZ, Chicago.

*Publication Committee:* EDWARD H. SKINNER,  
Chairman, 1532 Professional Bldg., Kansas City,  
Mo., HENRY SCHMITZ, Chicago, DOUGLAS QUICK,  
New York City.

*Research and Standardization Committee:* G.  
FAILLA, Chairman, Memorial Hospital, New York  
City, H. J. ULLMANN, Santa Barbara, Calif., R. B.  
GREENOUGH, Boston, Mass.

*Education and Publicity Committee:* SANFORD  
WITHERS, Chairman, 304 Republic Bldg., Denver,  
Colo., G. E. PFAHLER, Philadelphia, Pa., W. L. CLARK,  
Omaha, Nebr.

*Sixteenth Annual Meeting:* Atlantic City,  
N. J., September, 1931.

*Committee on Arrangements:* F. M. HODGES,  
Chairman, 1321 Spruce St., Philadelphia, Pa.,  
NEWCOMB, Philadelphia, Pa., W. L. CLARK, Philadelphia, Pa.



with resulting gain in life, the increasing incidence is more than keeping pace with palliative results will not reduce death rate, although they are of value. The increasing incidence of cancer must be fought by even greater percentages of actual cures. Everyone who has made a study of the subject agrees that there are only three points of attack to bring this about: still further improvement in the techniques of our present methods, a more widely executed early recognition of malignancy and research which will lead to a better understanding of neoplastic disease, and a discovery of its cause and possibly the elaboration of some new and successful form of treatment.

From another point of view, cancer and allied conditions comprise a very important economic problem under existing circumstances. The patient must submit to expensive methods of treatment if he is to pay his own way. He is very often deprived of his ability to work for a variable period of time, depending upon the kind and duration of treatment necessary and the chances of recovery. His family is often made responsible for his care and even his support. If he must become an object of charity, some institution must assume the cost of expensive treatment and even his keep and wages for a variable time. No other disease is so costly and complex.

Cancer is not a completely ameliorated or cured

National, state and state and municipal have had their interests in doing much good work. Even the Government has shown signs of interest. Concerted action to bring about the best possibilities must originate from definite preconceived plans which have been worked out carefully and judiciously. The medical groups, the American Society for the Control of Cancer and the Committee on the Treatment of Malignant Disease of the American College of Surgeons, have formulated basic plans which seem rational as a basis for future organized work. Their recommendations do not conflict with but make use of the groups or individuals who are working on the cancer problem at the present time. The recommendations of the two bodies are quite similar in essential or major details. We as radiologists must play a most important part in the success of treatment and we must direct every effort toward the most advantageous use of the means at our command. At the same time we must realize that we are but individual members of larger groups engaged in a work which requires concerted action.

In 1927, the American Society for the Control of Cancer appointed a committee composed of Drs. Ewing, Green, and Gerster to investigate the methods of treatment of cancer in this and other countries and to offer a report upon the methods generally and suggestions for the improvement of the treatment of cancer.

organizations  
in the fight against  
ly those doing research  
considerable duplication of  
In order to obviate this waste of

office would be a  
tive body and cou  
house where valua  
able, without duplicat  
vestigation.

HENRY K. *s or Clinics*  
Service may  
ipment of  
but this is  
some



land, 1407 S. Hope St., Los Angeles, 1931.  
Secretary, Dr. I. S. Trostler, 812 Marshall Field Annex, Chicago, Ill.  
Sixteenth annual session: Los Angeles, Calif., Dec. 1-5, 1930.

**RADIOLOGICAL SECTION, LOS ANGELES COUNTY MEDICAL SOCIETY**  
Secretary, Dr. Orville N. Meland, 1407 S. Hope St., Los Angeles.  
Meets on the third Wednesday of each month at the California Hospital.

**RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION**  
Secretary, Dr. W. S. Lawrence, Medical Arts Bldg., Memphis, Tenn.

**BUFFALO RADIOLOGICAL SOCIETY**  
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St.  
Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.

**CHICAGO ROENTGEN SOCIETY**  
Secretary, Dr. George M. Landau, 660 Groveland Park.  
Meeting second Thursday of each month October to May inclusive at Virginia Hotel.

**CLEVELAND RADIOLOGICAL SOCIETY**  
Secretary, Dr. A. Strauss, 518 Medical Arts Bldg.  
Meetings are held at 6:15 P.M. at the Cleveland Chamber of Commerce Club rooms on the fourth Monday of each month from October to April, inclusive.

**DETROIT ROENTGEN RAY AND RADIUM SOCIETY**  
Secretary, Dr. E. R. Witwer, Harper Hospital.  
Meets monthly on first Thursday from October to May, at Wayne County Medical Society Building.

**CENTRAL ILLINOIS RADIOLOGICAL SOCIETY**  
Secretary, Dr. C. Kariher, Decatur, Illinois.  
Regular meeting held quarterly.

**INDIANAPOLIS RADIOLOGICAL SOCIETY**  
Secretary, Dr. C. P. Harris, Indianapolis, Ind.  
Regular meeting held quarterly in Indianapolis.

**MINNEAPOLIS ROENTGEN SOCIETY**  
Secretary, Dr. C. P. Harris, Minneapolis, Minn.  
Next meeting to be announced.  
**NEW ENGLAND ROENTGEN RAY SOCIETY**  
Secretary, Dr. Thomas R. Healy, Boston, Mass.

Meets monthly on third Friday, Boston, Mass.  
**NEW YORK ROENTGEN SOCIETY**  
Secretary, Dr. J. Bennett Edwards, Englewood Hospital, Englewood, N. J.  
Meets monthly on third Monday, New York Academy of Medicine, at 8:30 P.M.

**CENTRAL NEW YORK ROENTGEN RAY SOCIETY**  
Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y.

Three meetings a year—April, August and November.  
**PACIFIC COAST ROENTGEN RAY SOCIETY**  
Secretary, Dr. Harold B. Thompson, Seattle, Wash.  
Two meetings a year.

**PENNSYLVANIA RADIOLOGICAL SOCIETY**  
Secretary, Dr. W. E. Reiley, Clearfield, Penna.  
Next meeting, Penn. McKee Hotel, McKeesport, Pa., May 13-14, 1931.

**PHILADELPHIA ROENTGEN RAY SOCIETY**  
Secretary, Dr. Karl Kornblum, 3400 Spruce St.  
Meeting first Thursday of each month from October to May inclusive, at 8:15 p.m., in Thomson Hall, College of Physicians, 19 S. 22d St.

**ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.**  
Secretary, Dr. Camp C. Thomas, 476 Lake Ave.  
Meets monthly on the first Friday evening at 7:45 at the Rochester Medical Association Building.

**ST. LOUIS ROENTGEN CLUB**  
Secretary-Treasurer, Dr. L. R. Sante, Missouri Bull.  
Meets first week of each month. Time and place of meetings designated by president.

**TEXAS RADIOLOGICAL SOCIETY**  
Secretary-Treasurer, Dr. C. P. Harris.  
Meets annually one day preceding the annual meeting of the American Association of Radiologists.





that x-ray cry  
to rep... from m  
sens...

B. COHEN

**TUMTHERAPIE, METHODEN UND AUSSICHTEN.** Dr. F. Gudzent, a.o. Professor an der Universität Berlin. Volume V of Medizinische Physik. Edited by Grote, Fromme, Warnekros. Pp. 106, with 53 illustrations. Price: Paper, 6.50 Marks; Bound, 8 Marks. Dresden: Theodor Steinkopff, 1929.

Gudzent was one of the first in Germany to study the clinical application of radium and other radioactive substances. In this monograph, he has succeeded in presenting a concise review of the physics, biologic effects, technique of application, and the therapeutic results obtained in the diseases amenable to treatment by radioactive preparations. The concluding chapter discusses "professional" injuries which have been observed particularly among the early workers. The safety rules adopted by the International Congress in Stockholm are also mentioned. This little book should appeal to the general practitioner as well as to the radiologist because it is easy to read and because the great experience of the author is evident throughout the text.

ERNST A. POHLE

**ULTRA-VIOLET RADIATIONS AND THEIR USES.** By Robert Aitken, M.D., F.R.C.P.E., Lecturer on Diseases of the Skin, Edinburgh University; Assistant Physician, Skin Department, Royal Infirmary, Edinburgh. Price 18/6. Edinburgh: W. & A. K. 1929.

harming. Irradiation. The author is of the value of ultraviolet for clinical purposes. A brief summary includes the book. The illustrations show the different types of apparatus used for light therapy in England; a few are photographs of patients before and after treatment.

The conservative attitude of the author and the practical nature of this treatise recommend it to the physician interested in ultraviolet radiation.

ERNST A. POHLE

## BOOKS RECEIVED

**DAS ULCUSPROBLEM IM LICHTE MODERNER RÖNTGENFORSCHUNG.** Von Priv.-Doz. Dr. H. U.-Albrecht, Oberarzt der medizinischen Universitäts-Klinik, Frankfurt a. M. Paper. Price, M. 10. Pp. 79, with 116 illustrations. Leipzig: Georg Thieme, 1930.

**OTOLOGISCHE RÖNTGENDIAGNOSTIK.** Von Dr. Ernst G. Mayer, Privatdozent für Röntgenologie, Assistent am Zentralröntgeninstitut, Professor G. Holzknacht, Wien. Klinischer Beitrag: Die Wertung und Verwendung der Röntgenbefunde in der Otologie. Von Dr. Karl Eisinger, Assistent und otologischer Referent der Univ.-Klinik für Ohren-, Nasen- und Kehlkopfkrankheiten, Professor Dr. H. Neumann, Wien. Price, Rm. 75.00; bound, price Rm. 78.60. Pp. 35, with 6 illustrations and 6 tables. Wien: Julius Springer, 1930.

**ALLGEMEINE GRUNDLAGEN.** Physik und Technik des Röntgenverfahrens. (Radiologische Praktika. Band 21.) Von Ing. M. Brenzinger, A. Janitzky und Dr. E. Wilfong. Universitäts-Institut für physikalische Grundlagen der Röntgenstrahlung, Frankfurt a. M. Cloth. Price, Rm. 25.50. Pp. 112, with 14 illustrations. Leipzig: Georg Thieme, 1930.

**DAS RÖNTGENVERFAHREN.** Ein Lehrbuch für die technische Assistentin. Von Dr. Kurt Kienast, Assistent für Röntgenologie in Berlin. Paper, price 25.00; bound, price 26.00. Pp. 345, with 283 illustrations. Leipzig: Georg Thieme, 1930.

**LA RÖENTGENTHERAPIE; SES INDICATIONS CLINIQUES.** Dr. Iser Solomon, radiologiste de l'Hôpital Saint-Jacques, Paris. Price, 2 fr. Pp. 32, with 14 illustrations. Paris: Scienteig, 1930.

factor in	698
apparatus for roent-	699
sinuses	699
Roentgenology of the	699
nasal sinuses	699
Iodized oil as an aid in the	699
diagnosis of chronic maxillary sinus dis-	699
ease	699

#### Neck and Chest

The azygos lobe of the right	699
lung and its clinical significance	699
Experimental contribution to the	700
roentgen diagnosis of miliary pulmonary	700
tuberculosis	700
The description of	700
pathologic lung shadows in terms of clouds	700
The intercleido-hilar onset	700
of pulmonary tuberculosis	701
Chest	701
roentgenograms of nontuberculous chil-	701
dren suspected of being tuberculous	701
Pleurisy in infants and	701
children	701
The diagnosis of pleural adhesions	701
The roentgenological	701
aspects of empyema	701
and JAUBERT DE BEAUJEU, A.:	702
interesting cases of hydatid cysts of	702
the lungs	702
Pneumoconiosis of the Ruhr	702
and lung carcinoma	702
C. M., and ADAMS, W. E.: The	702
destructive pulmonary	702
Postoperative pulmonary	702
and bronchial obstruction	702
and LEUNDA, J.:	703
inhalation of lipiodol in chil-	703
dren by means of	703
Foreign	703

When has v	707
significance	707
Some clinical features	707
of air swallowing	707
Roentgenologic observation	707
on benign tumors of the stomach	707
Anatomical consid	707
of the ulcer bearing area (lesse	707
curvature	707
of the stomach, pylorus and	707
st part of	707
the duodenum)	707
Further observations on the	707
direct roentgenologic signs of gastroje-	707
junal and jejunal ulcer	707
A study of intestinal tuber-	707
culosis among ex-servicé men	707
Acute hematogenous (metastatic) peri-	708
nephric abscesses	708
On the lipiodol roentgen diagnosis of	709
lesions of the biliary tract in fistulae	709
The emptying of the gallbladder	709
following restoration from acute experi-	709
mental cholecystitis	709

#### Gynecology and Obstetrics

The value of a lateral view in	709
diagnosis of pregnancy	709
Roentgenographic examina-	709
tion of the female pelvic organs	709

#### Genitourinary System

and BUMPUS, HER-	702
MON C. Jr.: Ureteral kinks; how	702
occur at the orifice "take a deep brea"	702
and it"	702
M. us, H. Fe	702

#### Nervous System

DAVIS, LOYAL	703
THEODO	703
of iodiz	703
space	703